New Hampshire Volunteer River Assessment Program

2001

OYSTER RIVER

Water Quality Report

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

February 2003

NHDES-R-WD-03-6

STATE OF NEW HAMPSHIRE

Volunteer River Assessment Program

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Water Quality Report

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 HAZEN DRIVE
CONCORD, N.H. 03301

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February 2003

Printed on Recycled Paper

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1. ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services-Volunteer River Assessment Program extends sincere thanks to the volunteers in the Oyster River watershed during 2001. This report was created solely from the data collected by the volunteers listed, below. It is their time and dedication that not only contributes to the amount of knowledge of rivers and streams in New Hampshire, but also expresses the genuine concern for local water resources.

Dan Abramson
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2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

The Volunteer River Assessment Program (VRAP) supports watershed organizations in their efforts to monitor river water quality. The primary focus of VRAP is to provide volunteers with river monitoring guidelines, equipment loans, and technical training. DES also incorporates applicable volunteer monitoring results into its evaluation of New Hampshire surface waters. Annual reports for each VRAP river include a summary of monitoring results and recommendations for future water quality sampling. VRAP aims to foster public understanding and stewardship of river systems and to increase available water quality information about New Hampshire rivers and streams.

VRAP loans and maintains water monitoring kits that include meters and supplies for on-station measurement of five basic water quality parameters: water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. The investigation of these and additional parameters such as nutrients, metals, and *E. coli* is conducted by state water quality personnel and may be augmented by volunteer sampling. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results meeting DES Quality Assurance and Quality Control (QA/QC) requirements supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

VRAP typically recommends sampling every other week during the summer, and citizen monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. Training sessions are typically conducted outdoors near surface waters for an interactive demonstration. During the training, volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory

analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

Applicable volunteer data are input to a water quality database, and considered (along with other reliable sources of data) during periodic DES water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act.

The success of the Oyster, Ashuelot, Lamprey, Exeter, Sugar, Powwow, Cocheco, and other river volunteer programs throughout the state are a direct result of the hard work and dedication of citizen volunteers and many additional people who helped to plan, support, and carry out these monitoring efforts.

3. PROJECT SUMMARY: OYSTER RIVER VRAP

Water quality monitoring of the Oyster River by the volunteers included in the VRAP began in 2001. Water samples were collected from sites on the mainstem and tributaries throughout the watershed, particularly those associated with UNH drinking water intakes. The volunteers were not only interested in the core VRAP water quality monitoring parameters, but were also interested in determining the concentrations of dissolved ions, chloride, color, and UV.

During 2001, sampling was focused on 14 stations along the river and tributaries, including the towns of Lee, Durham, and Madbury. Samples were collected every two weeks during June through September, and approximately monthly from October through December.

4. RESULTS, DISCUSSION, AND RECOMMENDATIONS

This section includes a description of the Oyster River VRAP 2001 monitoring locations and results, a discussion of the results in comparison with New Hampshire surface water quality standards, and recommendations for future sampling and watershed investigations. The VRAP monitoring locations, "stations", are discussed from upstream to downstream (see table in Appendix A). Each station is shown on a map. Results are presented in graphs and text prepared by the VRAP, and tables including all monitoring results from each station are located in Appendix B. The discussion of the results

includes recommendations for future sampling and investigations that will contribute to the assessment of water quality conditions.

The water quality information collected at each station is summarized in a table that provides the reader with an overview of the monitoring activities and results. The table can be used as a quick reference for the reader; results not meeting state water quality criteria do not necessarily indicate a violation of surface water quality standards. The summary table indicates: (1) the number and type of samples collected, (2) the number of samples collected according to quality assurance and quality control requirements, (3) the number of samples not meeting state water quality criteria, (4) the range of the measurements, and (5) abbreviated surface water quality standards.

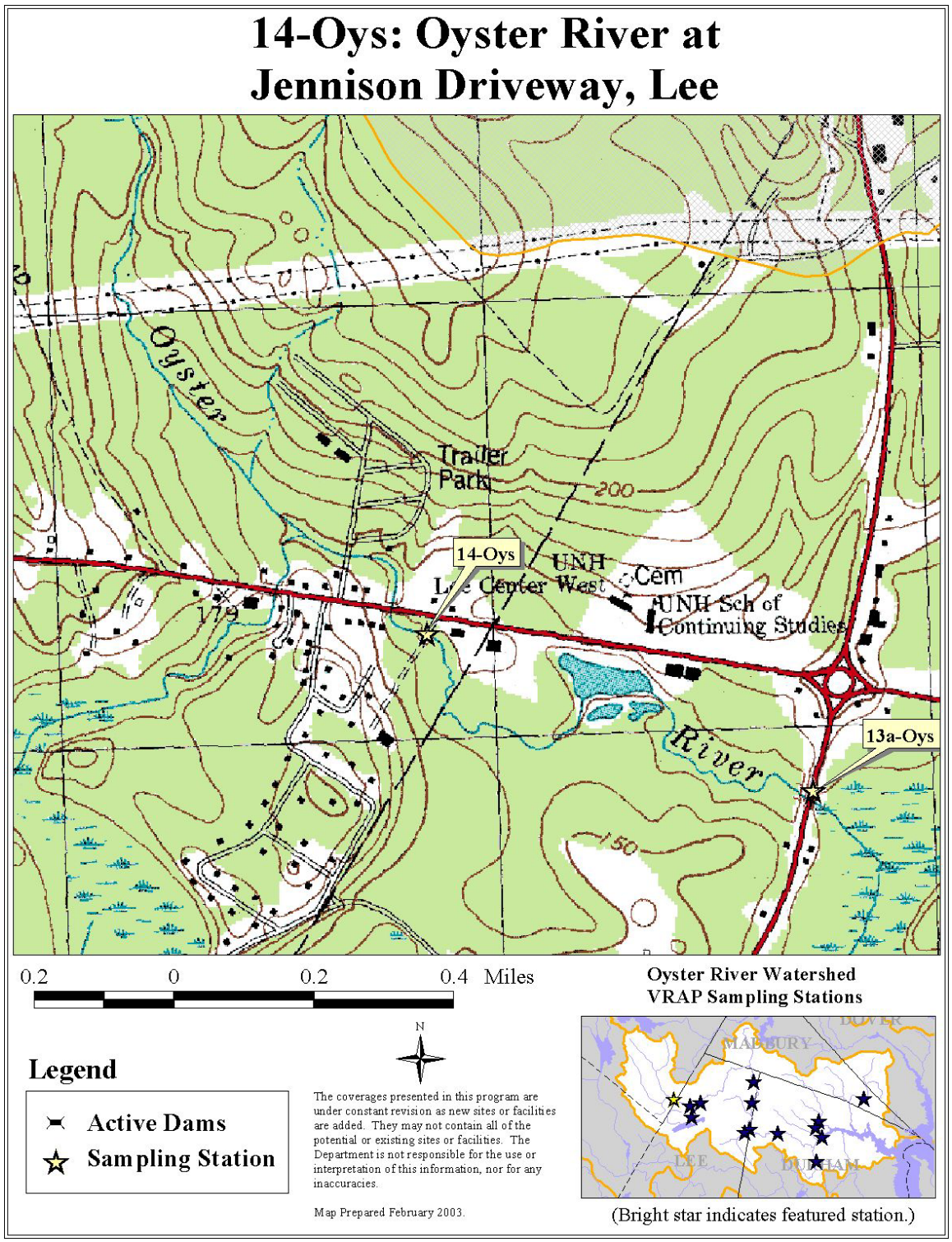
The presentation and discussion of the volunteer results focuses primarily on three parameters: DO, pH, and *E. coli*. These parameters are the core of the VRAP monitoring system, and have relatively straightforward standards that lend themselves to the assessment of individual results. These results can contribute directly to the determination of fishable and swimmable river and stream conditions, which is often a primary volunteer monitoring goal. Graphs of dissolved oxygen (DO) concentrations and water temperature, and *E. coli* bacteria are included in the discussion, and aide the reader in understanding the results. Appendix C provides descriptions of the water quality parameters analyzed under VRAP during 2000 and the associated New Hampshire surface water quality standards (SWQS) for Class B waters.

The current report format will describe water quality conditions on a station-by-station basis. The reader should note that discussion is limited to those parameters at each station that do not meet state criteria, or where more data are necessary. For example, since *E. coli* counts exceeded the state instantaneous criteria at 14-Oys, *E. coli* will be discussed in detail. However, recommendations are not limited to parameters with results that fall outside state criteria.

VRAP aims to provide a mechanism for citizens to contribute to the ongoing process of surface water quality assessment. Recommendations for future monitoring activities and watershed investigations are included in this report following the results and discussion. Also included are recommendations for improvements in sampling techniques to encourage volunteers to adhere to quality assurance and control measures.

Volunteers are encouraged to sample their rivers and streams on a long-term basis. Much of the information volunteers collect profiles river and stream locations for the first time. Several (five to ten) years of good quality measurements will be needed to begin to decipher water quality trends and the status of rivers and streams relative to the New Hampshire surface water quality standards. Water quality data from the stretch of river sampled by volunteers are presented in graphs in Appendix D. These graphs are included in the report to show how water quality conditions change from upstream to downstream. All results generated by the Oyster River VRAP 2001 were collected using the VRAP Field Datasheet and Field Sampling Protocols, 2001 (see Appendix E).

4.1. 14-Oys: Jennison Driveway, Lee, NH



4.1.1. Results and Discussion

Eleven measurements were made in the field for dissolved oxygen (DO), pH, turbidity, and conductivity using handheld meters (Table 1). Six samples were collected for *E. coli* bacteria, and several samples were collected for various parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Two *E. coli* samples were below the Class A surface water quality standards. The DO concentration data do not show any apparent DO problems, although one DO % saturation measurement was below 75%. However, these data alone do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.1.1.1, below).

Table 1. Monitoring Summary: 14-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	11	11	0	6.93 - 11.7	**>6.0**
DO (% sat.)	11	11	1	74.8 - 99	**>75**
pH (std. units)	11	11	0	5.63 - 7.16	**naturally occuring**
Turbidity (NTU)	11	11	0	0.6 - 2.17	**naturally occuring**
Conductivity (µmho/cm)	11	11	0	62.9 - 162.7	**NA**
***E. coli* (CTS/100mL)**	6	6	2	10 - >2000	**<153**
Calcium (mg/L)	4	4	0	3.17 - 5.82	**NA**
Chloride (mg/L)	4	4	0	21.36 - 35.53	**<860**
Magnesium (mg/L)	4	4	0	0.93 - 1.55	**NA**
Nitrate (mg/L)	4	4	0	0.013 - 0.217	**NA**
Nitrite (µg/L)	4	4	0	2 - 5	**NA**
Potassium (mg/L)	4	4	0	0.73 - 1.96	**NA**
Sodium (mg/L)	4	4	0	13.02 - 22.38	**NA**
Color (Color Units, 455 T)	5	5	0	80 - 240	**NA**
UV-254 (abs)	5	5	0	0.302 - 0.898	**NA**

Ammonia (µg/L)	4	4	0	9 - 27	*
Sulfate (mg/L)	4	4	0	0.41 - 1.46	**NA**
Phosphate (µg/L)	4	4	0	2 - 9	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.1.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 14-Oys were greater than the minimum instantaneous concentration of 6 mg/L (see Figure 1). Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class A New Hampshire surface water quality standards for DO include a minimum concentration of 6.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Additional sampling is necessary at this station.

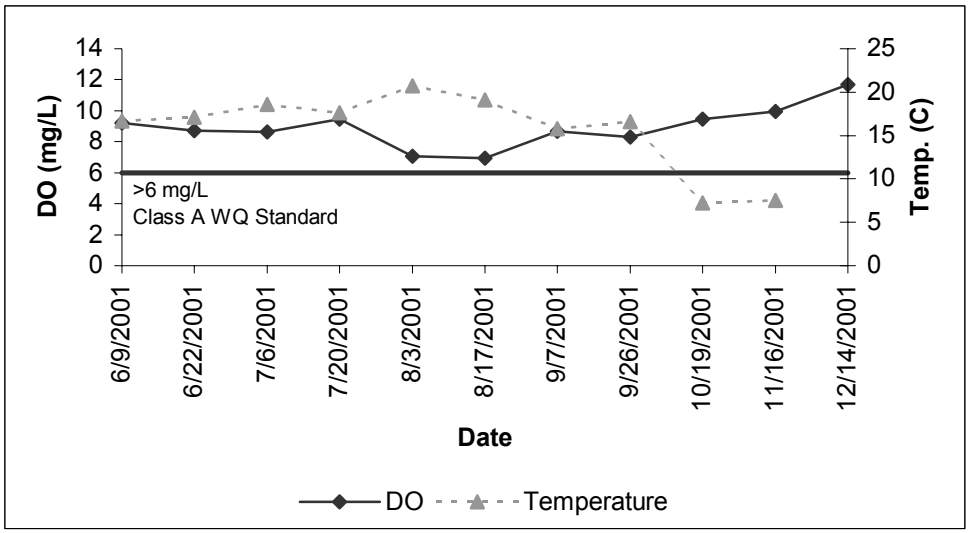


Figure 1. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 14-Oys, Jennison Driveway, Lee, NH. VRAP, Year 2001.

4.1.1.2. pH

The pH at this location ranged from 5.63 to 7.16. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurring*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels.

4.1.1.3. *E. coli*

Figure 2 shows instantaneous *E. coli* counts on six dates during 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded twice. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

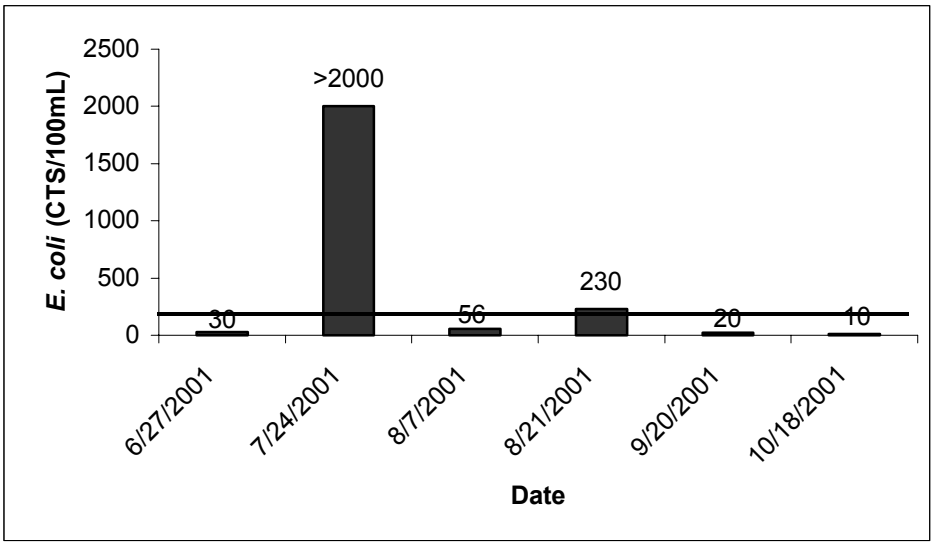


Figure 2. *E. coli* bacteria counts. Oyster River at 14-Oys, Jennison Driveway, Lee, NH. VRAP, Year 2001.

4.1.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

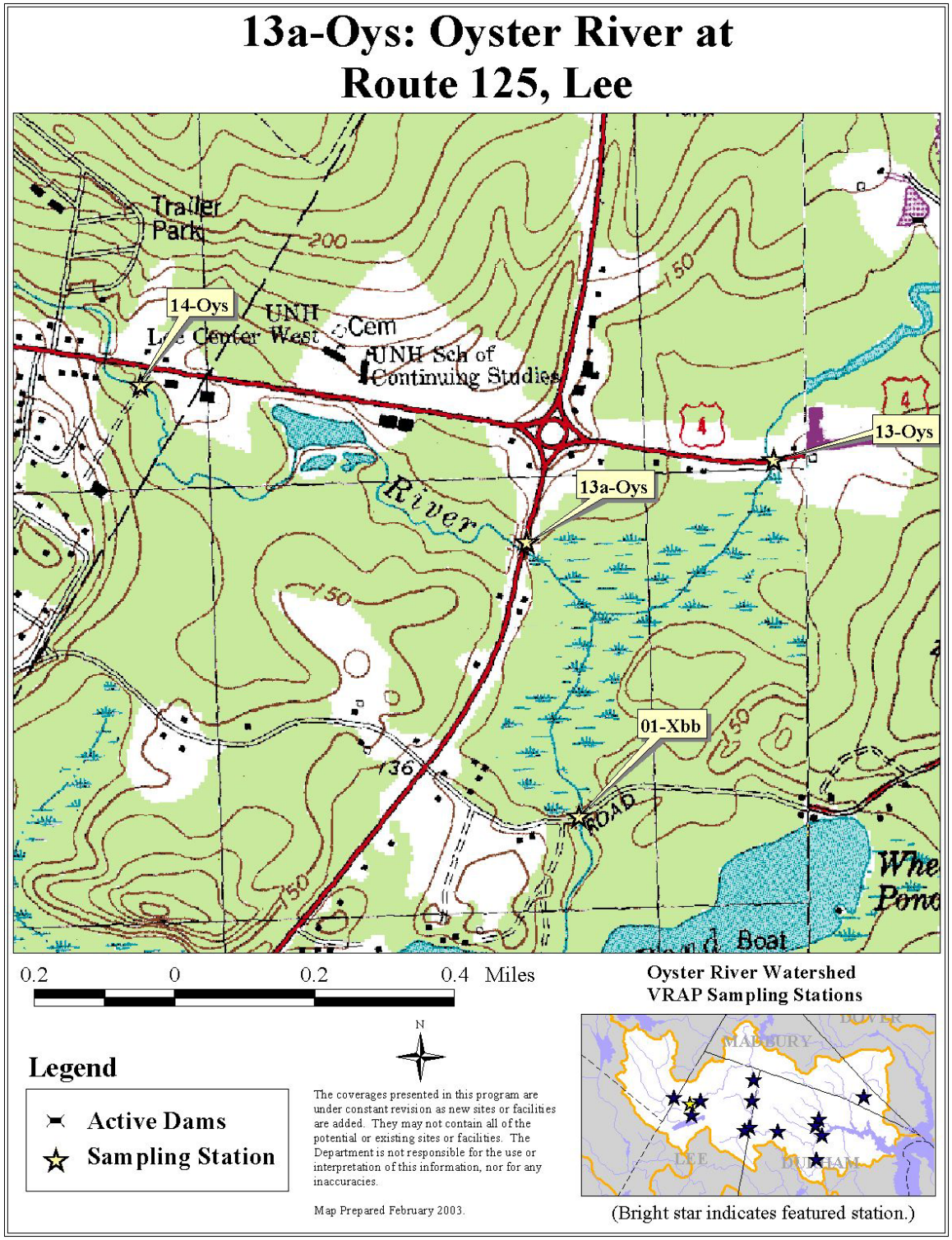
  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and provide early detection of changes in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.2. 13a-Oys: Route 125, Lee, NH



4.2.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) and pH, and eleven were made for conductivity and turbidity using handheld meters (Table 2). Six samples were collected for *E. coli* bacteria, and several samples were collected for various parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Twelve measurements for DO % saturation were lower than 75%, and ten measurements were less than the minimum instantaneous concentration of 6 mg/L. This indicates a potnential DO problem at this site (see explanation in Section 4.2.2.1, below).

Table 2. Monitoring Summary: 13a-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	10	2.29 - 9	**>6.0**
DO (% sat.)	13	13	12	25.8 - 82.1	**>75**
pH (std. units)	13	13	0	4.84 - 6.44	**naturally occuring**
Turbidity (NTU)	11	11	0	2.4 - 6.2	**naturally occuring**
Conductivity (µmho/cm)	11	11	0	77.3 - 177	**NA**
***E. coli* (CTS/100mL)**	6	6	0	30 - 120	**<153**
MTBE	3	3	0	undetected	
Calcium (mg/L)	5	5	0	2.89 - 5.28	**NA**
Chloride (mg/L)	5	5	0	18.5 - 40.01	**<860**
Magnesium (mg/L)	5	5	0	0.83 - 1.62	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.026	**NA**
Nitrite (µg/L)	5	5	0	2 - 6	**NA**
Potassium (mg/L)	5	5	0	0.78 - 2.31	**NA**
Sodium (mg/L)	5	5	0	11.8 -23.45	**NA**
Color (Color Units, 455 T)	5	5	0	65 - 240	**NA**

UV-254 (abs)	5	5	0	0.38 - 0.844	**NA**
Ammonia (µg/L)	5	5	0	23 - 197	*
Sulfate (mg/L)	5	5	0	0.24 - 1.6	**NA**
Phosphate (µg/L)	5	5	0	2 - 44	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.2.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 13a-Oys were, on many occasions, less than the minimum instantaneous concentration of 6 mg/L (see Figure 3). The Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

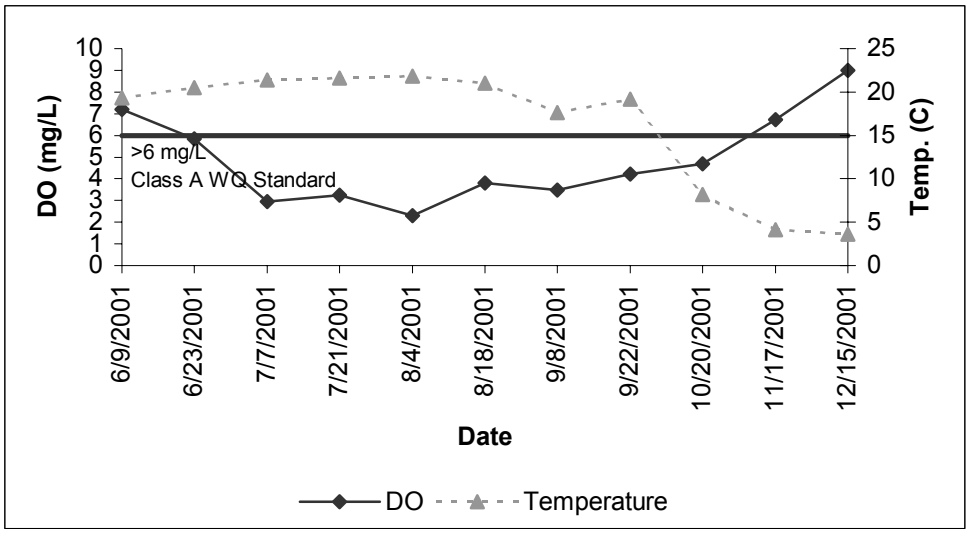


Figure 3. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 13a-Oys, Route 125, Lee, NH. VRAP, Year 2001.

4.2.1.2. pH

The pH at this location ranged from 4.84 to 6.44. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall as*

naturally occurring. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.2.1.3. *E. coli*

Figure 4 shows the instantaneous *E. coli* counts on six dates during summer and early fall 2001.

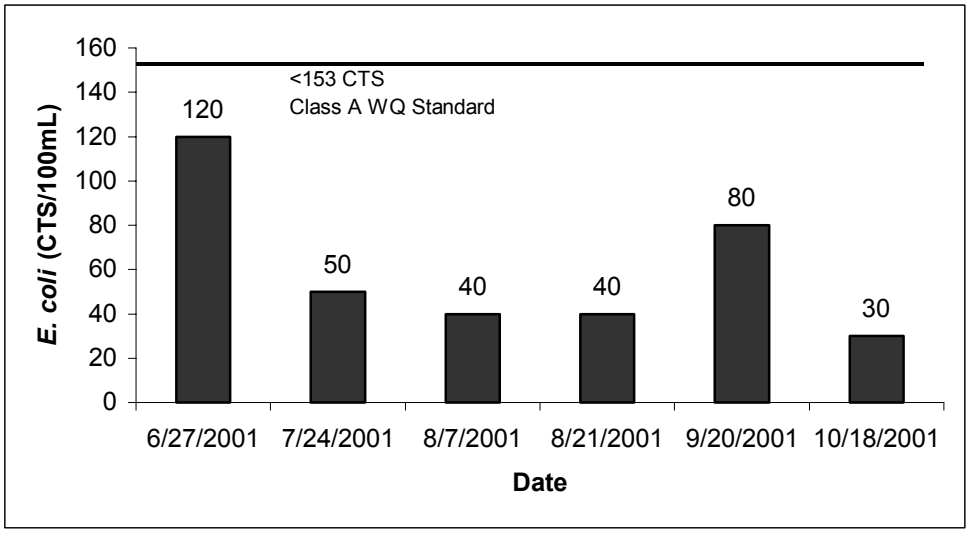


Figure 4. *E. coli* Bacteria Counts. Oyster River at 13a-Oys, Route 125, Lee, NH. VRAP, Year 2001.

4.2.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

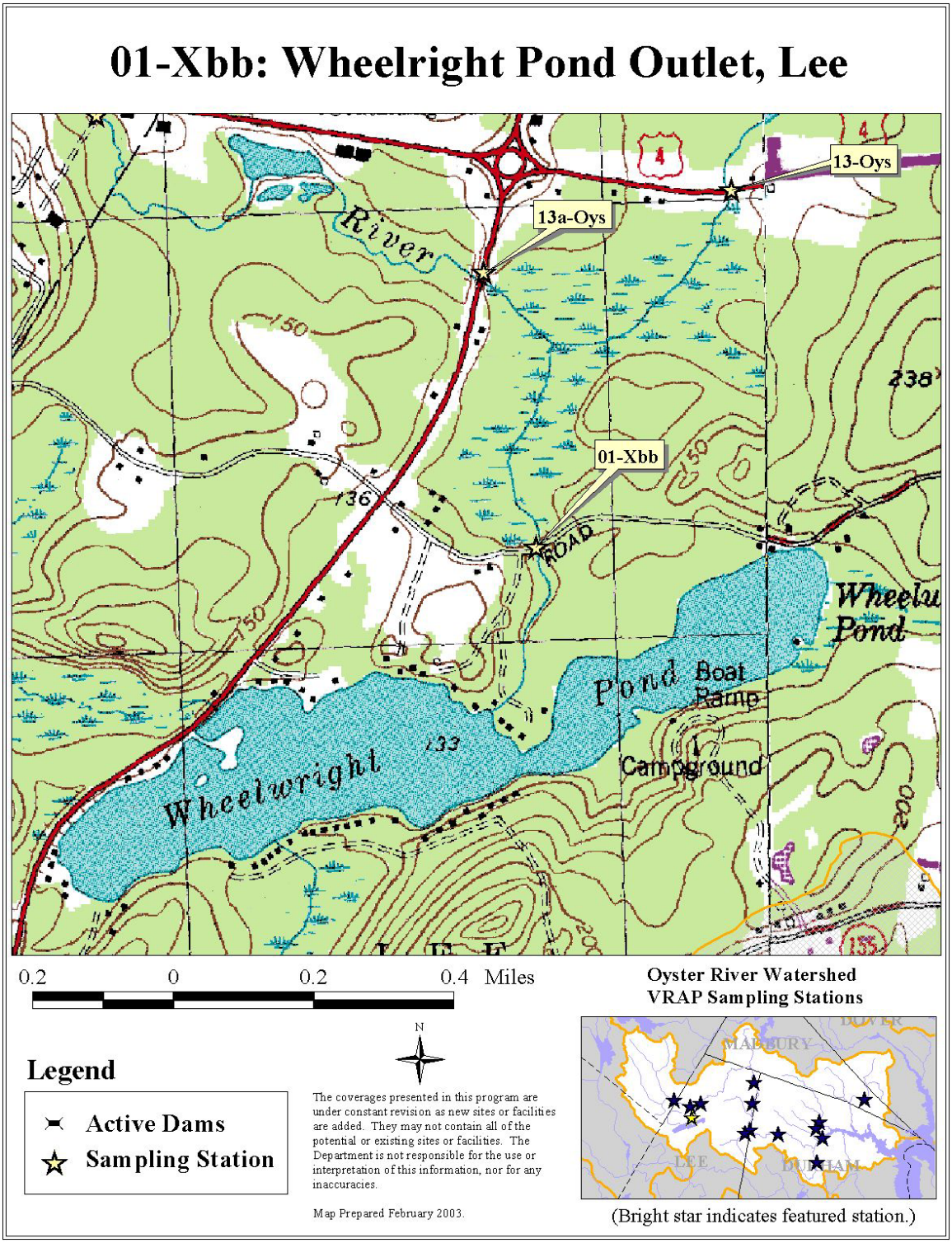
  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and provide early detection of changes in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a

Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.3. 01-Xbb: Wheelwright Pond Outlet, Lee, NH



4.3.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) and pH, and eleven were made for turbidity and conductivity using handheld meters (Table 3). Five samples were collected for *E. coli* bacteria and several other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data show an apparent DO problem. However, it should be understood that these data alone do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.3.1.1, below).

Table 3. Monitoring Summary: 01-Xbb, VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	8	4.14 - 9.82	**>6.0**
DO (% sat.)	13	13	11	45 - 86.6	**>75**
pH (std. units)	13	13	0	5.81 - 6.75	**naturally occuring**
Turbidity (NTU)	11	11	0	0.97 - 2.75	**naturally occuring**
Conductivity (µmho/cm)	11	11	0	78.7 - 135.5	**NA**
***E. coli* (CTS/100mL)**	5	5	1	<10 - 260	**<153**
Calcium (mg/L)	5	5	0	7.89 - 9	**NA**
Chloride (mg/L)	5	5	0	19.25 - 22.08	**<860**
Magnesium (mg/L)	5	5	0	1.64 - 1.84	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.019	**NA**
Nitrite (µg/L)	5	5	0	2 - 6	**NA**
Potassium (mg/L)	5	5	0	1.2 - 2.31	**NA**
Sodium (mg/L)	5	5	0	12.16 - 13.22	**NA**
Color (Color Units, 455 T)	5	5	0	27 - 100	**NA**
UV-254 (abs)	5	5	0	0.261 - 0.332	**NA**
Ammonia (µg/L)	5	5	0	19 - 104	*

Sulfate (mg/L)	5	5	0	0.95 - 1.93	**NA**
Phosphate (µg/L)	5	5	0	5 - 11	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.3.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 01-Xbb were, on several occasions, less than the minimum instantaneous concentration of 6 mg/L (see Figure 5). The Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

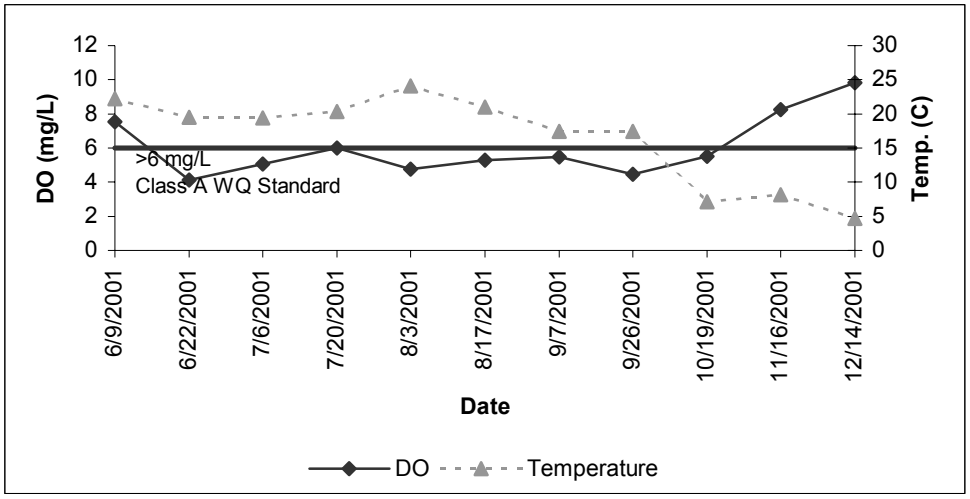


Figure 5. Dissolved Oxygen (DO) Concentration vs. Temperature. Wheelright Pond Outlet at 01-Xbb, Lee, NH. VRAP, Year 2001.

4.3.1.2. pH

The pH at this location ranged from 5.81 to 6.75. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurs*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.3.1.3. *E. coli*

Figure 6 shows instantaneous *E. coli* counts on five dates during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

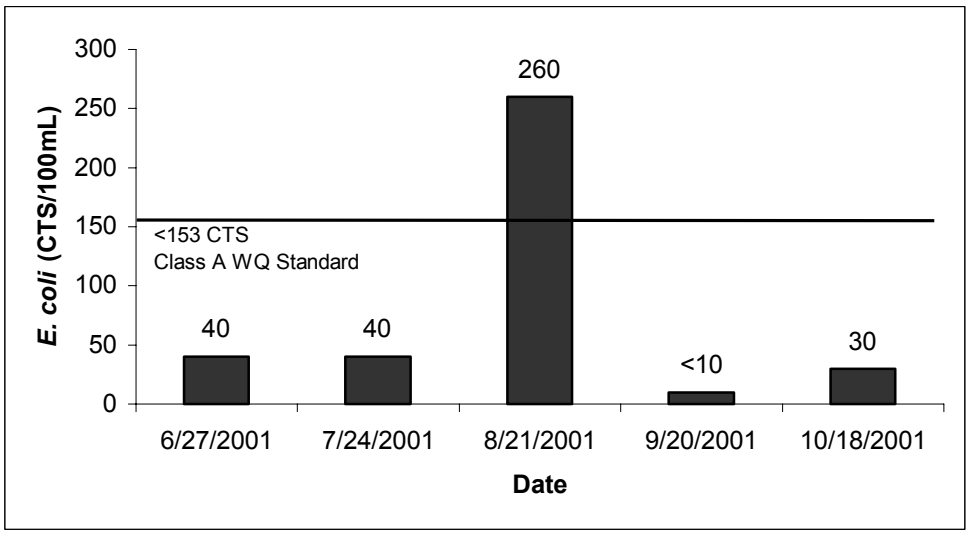


Figure 6. *E. coli* Bacteria Counts. Wheelright Pond Outlet at 01-Xbb, Lee, NH. VRAP, Year 2001.

4.3.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

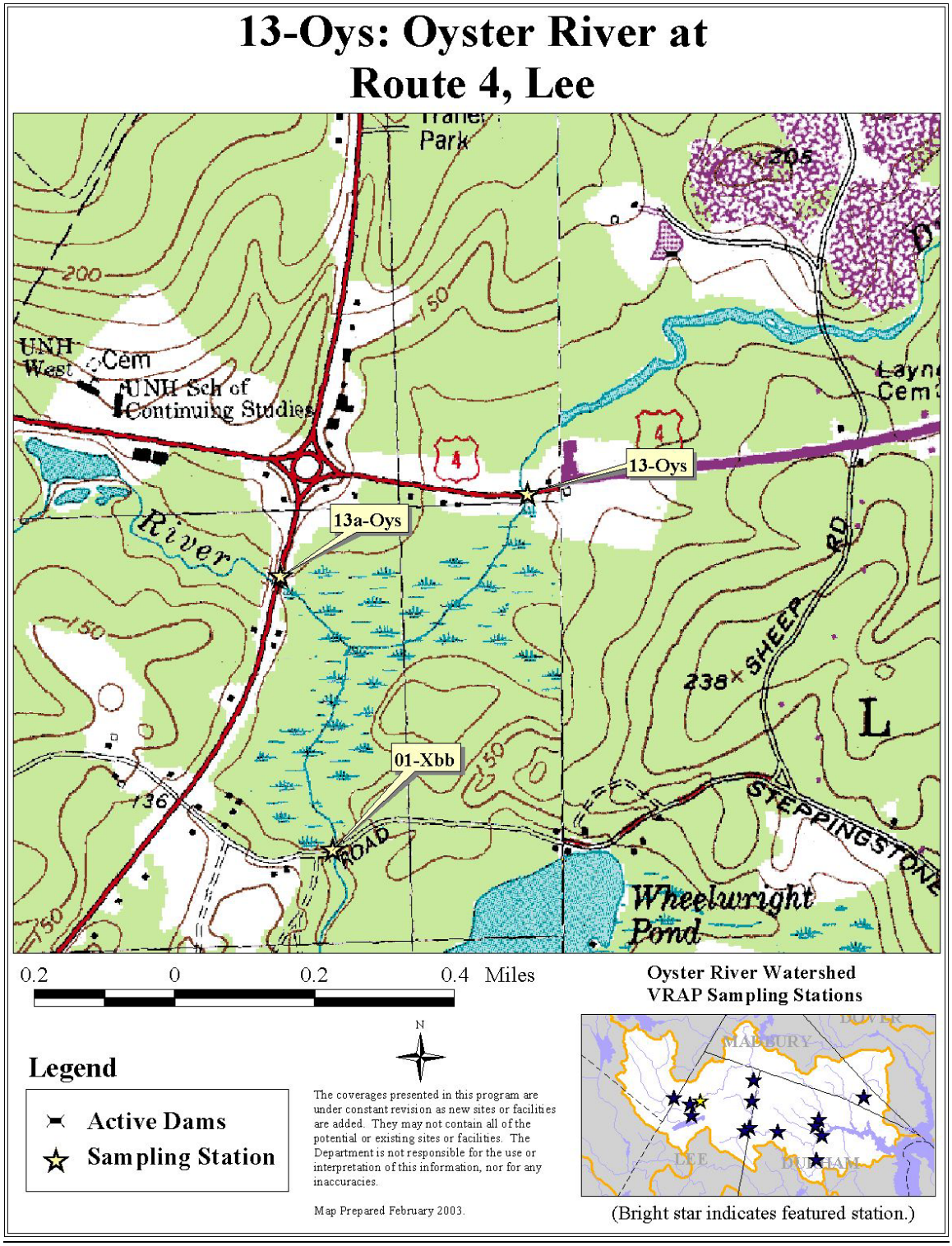
  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and track the current potential problem that occurred during August. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.4. 13-Oys: Route 4, Lee, NH



4.4.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) and pH, and eleven were made for turbidity and conductivity using handheld meters (Table 4). Five samples were collected for *E. coli* bacteria, and several samples were collected for various parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data show an apparent DO problem. However, it should be noted that these data alone do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.4.1.1, below). One *E. coli* sample exceeded the Class A water quality standard.

Table 4. Monitoring Summary: 13-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	12	2.33 - 7.31	**>6.0**
DO (% sat.)	13	13	13	25.7 -53.3	**>75**
pH (std. units)	13	13	0	4.21 - 6.73	**naturally occuring**
Turbidity (NTU)	11	11	0	1.8 - 5.2	**naturally occuring**
Conductivity (μmho/cm)	11	11	0	86 - 215	**NA**
***E. coli* (CTS/100mL)**	5	5	1	<10 - 340	**<153**
MTBE	3	3	0	undetected	
Calcium (mg/L)	5	5	0	4.35 - 9.83	**NA**
Chloride (mg/L)	5	5	0	19.06 - 48.23	**<860**
Magnesium (mg/L)	5	5	0	1 - 2.21	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.018	**NA**
Nitrite (μg/L)	5	5	0	2 - 8	**NA**
Potassium (mg/L)	5	5	0	0.86 - 3.53	**NA**
Sodium (mg/L)	5	5	0	11.93 - 24.93	**NA**
Color (Color Units, 455 T)	5	5	0	85 - 220	**NA**

UV-254 (abs)	5	5	0	0.436 - 0.79	**NA**
Ammonia (µg/L)	5	5	0	9 - 76	*
Sulfate (mg/L)	5	5	0	0 - 2.56	**NA**
Phosphate (µg/L)	5	5	0	2 - 10	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.4.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 13-Oys were, on most occasions, less than the minimum instantaneous concentration of 6 mg/L (see Figure 7). The Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

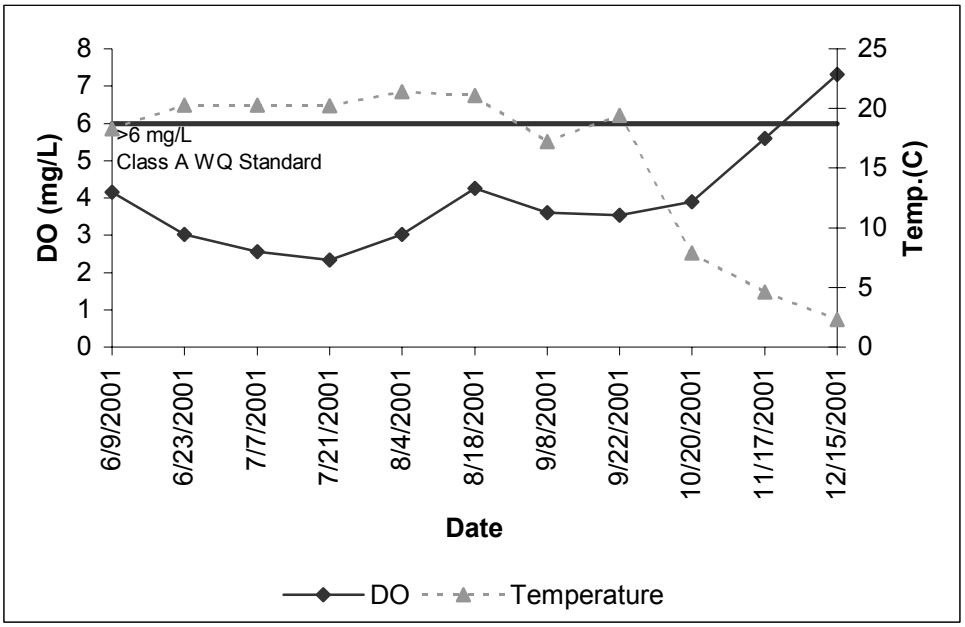


Figure 7. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 13-Oys, Route 4, Lee, NH. VRAP, Year 2001.

4.4.1.2. pH

The pH at this location ranged from 4.21 to 6.73. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is

influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurs*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.4.1.3. *E. coli*

Figure 8 shows the instantaneous *E. coli* counts during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

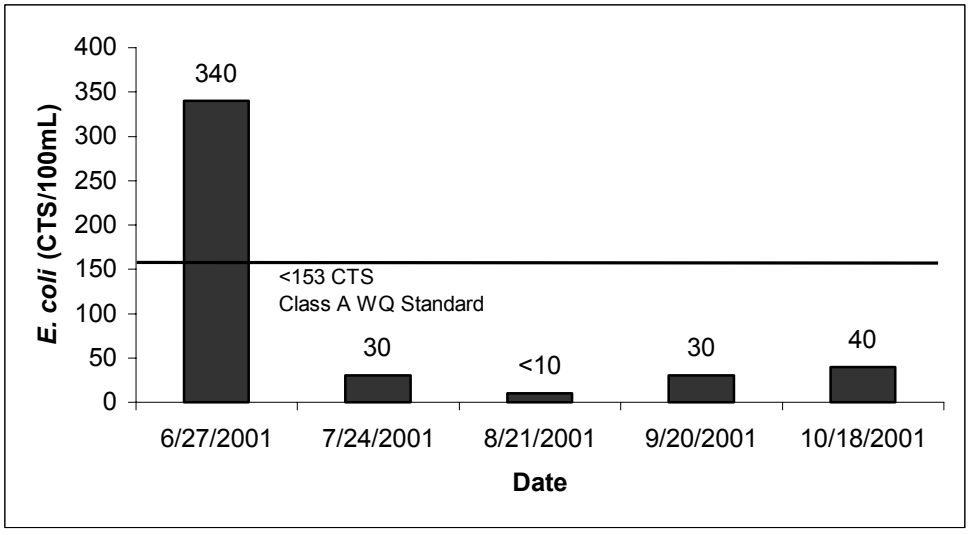


Figure 8. *E. coli* Bacteria Counts. Oyster River at 13-Oys, Route 4, Lee, NH. VRAP, Year 2001.

4.4.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

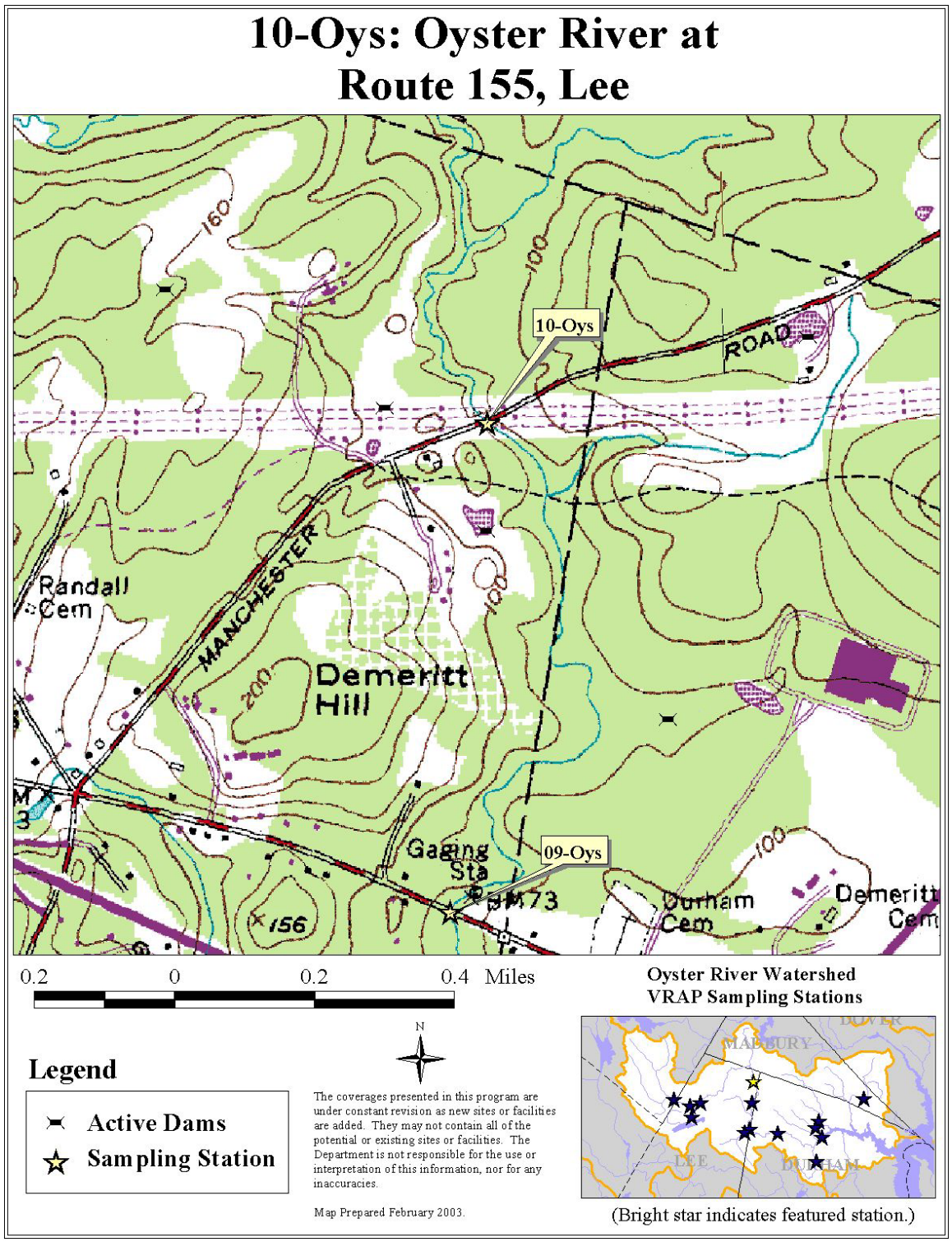
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E.*

coli, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and track the current potential problem that occurred during August. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.5. 10-Oys: Route 155, Lee, NH



4.5.1. Results and Discussion

Fourteen measurements were made in the field for dissolved oxygen (DO), 15 were made for pH, and 13 were made for turbidity and conductivity using handheld meters (Table 5). Four samples were collected for *E. coli* bacteria, and five samples were collected for several other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data do not show an apparent DO problem, although four of the DO % saturation measurements were below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.5.1.1, below). One *E. coli* sample exceeded the instantaneous Class A water quality standard.

Table 5. Monitoring Summary: 10-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	6.02 - 11.3	**>6.0**
DO (% sat.)	14	14	4	64.3 - 104.1	**>75**
pH (std. units)	15	15	0	6.0 - 7.02	**naturally occuring**
Turbidity (NTU)	13	13	0	2.98 - 11.4	**naturally occuring**
Conductivity (µmho/cm)	13	13	0	121.5 - 270.2	**NA**
***E. coli* (CTS/100mL)**	4	4	1	10 - 170	**<153**
Calcium (mg/L)	5	5	0	8.21 - 11.6	**NA**
Chloride (mg/L)	5	5	0	37.44 - 59.73	**<860**
Magnesium (mg/L)	5	5	0	1.7 - 2.58	**NA**
Nitrate (mg/L)	5	5	0	0.022 - 0.088	**NA**
Nitrite (µg/L)	5	5	0	1 - 6	**NA**
Potassium (mg/L)	5	5	0	1.69 - 2.65	**NA**
Sodium (mg/L)	5	5	0	19.67 - 36.17	**NA**
Color (Color Units, 455 T)	5	5	0	80 - 180	**NA**
UV-254 (abs)	5	5	0	0.222 - 0.592	**NA**

Ammonia (µg/L)	5	5	0	5 - 76	*
Sulfate (mg/L)	5	5	0	0.82 - 2.3	**NA**
Phosphate (µg/L)	5	5	0	6 - 8	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.5.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 10-Oys were greater than the minimum instantaneous concentration of 6 mg/L (see Figure 9). However, the Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day.

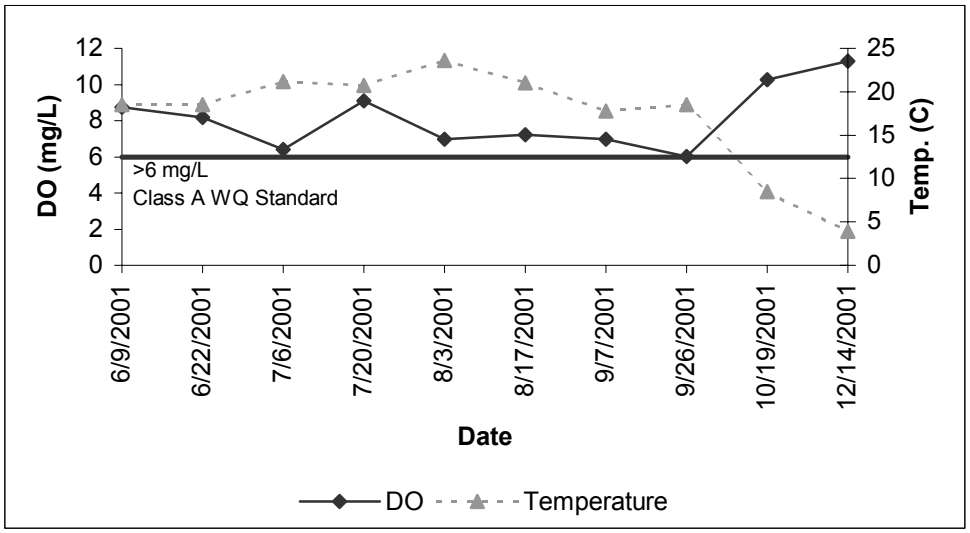


Figure 9. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 10-Oys, Route 155, Lee, NH. VRAP, Year 2001.

4.5.1.2. pH

The pH at this location ranged from 6.00 to 7.02. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurring*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New

Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.5.1.3. *E. coli*

Figure 10 shows instantaneous *E. coli* counts on four dates during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

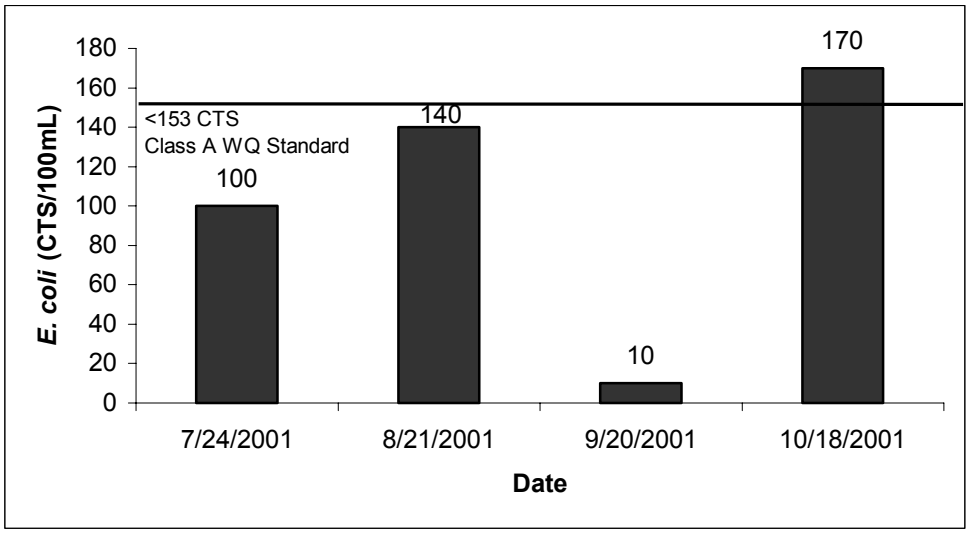


Figure 10. *E. coli* bacteria counts. Oyster River at 10-Oys, Route 155, Lee, NH. VRAP, Year 2001.

4.5.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

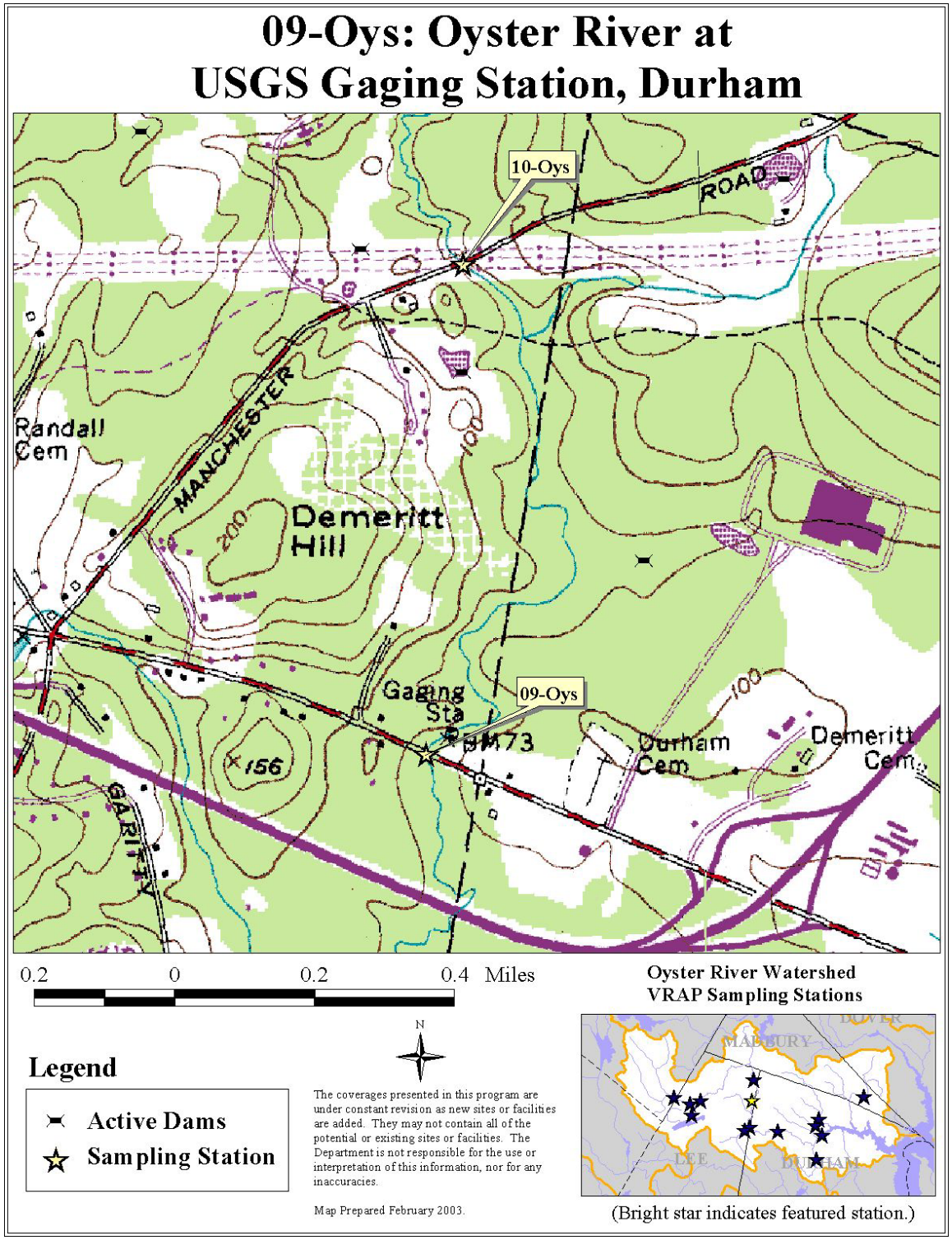
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of

E. coli in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.6. 09-Oys: Gaging Station, Lee, NH



4.6.1. Results and Discussion

Twelve measurements were made in the field for dissolved oxygen (DO) and pH, and eleven were made for turbidity and conductivity using handheld meters (Table 6). Five samples were collected for *E. coli* bacteria, and several samples were collected for other various parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data show an apparent DO problem. However, it should be noted that these data alone do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.6.1.1, below). One *E. coli* sample exceeded the Class A water quality standard.

Table 6. Monitoring Summary: 09-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	12	12	5	4.56 - 10.91	**>6.0**
DO (% sat.)	12	12	10	50.8 - 81	**>75**
pH (std. units)	12	12	0	5.26 - 7.03	**naturally occuring**
Turbidity (NTU)	11	11	0	4 - 17	**naturally occuring**
Conductivity (µmho/cm)	11	11	0	120 - 285.5	**NA**
***E. coli* (CTS/100mL)**	5	5	1	40 - 370	**<153**
Calcium (mg/L)	5	5	0	8.34 - 12.96	**NA**
Chloride (mg/L)	5	5	0	32 - 61.53	**<860**
Magnesium (mg/L)	5	5	0	1.8 - 3.16	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.066	**NA**
Nitrite (µg/L)	5	5	0	0 - 6	**NA**
Potassium (mg/L)	5	5	0	1.44 - 2.76	**NA**
Sodium (mg/L)	5	5	0	19.89 - 35.27	**NA**
Color (Color Units, 455 T)	4	4	0	60 - 220	**NA**

UV-254 (abs)	4	4	0	0.156 - 0.586	**NA**
Ammonia (µg/L)	5	5	0	6 - 79	*
Sulfate (mg/L)	5	5	0	0.87 - 2.83	**NA**
Phosphate (µg/L)	5	5	0	6 - 9	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**
**** Metals standards represent fresh water acute criteria.**

4.6.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 09-Oys were, on several occasions, less than the minimum instantaneous concentration of 6 mg/L (see Figure 11). The Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

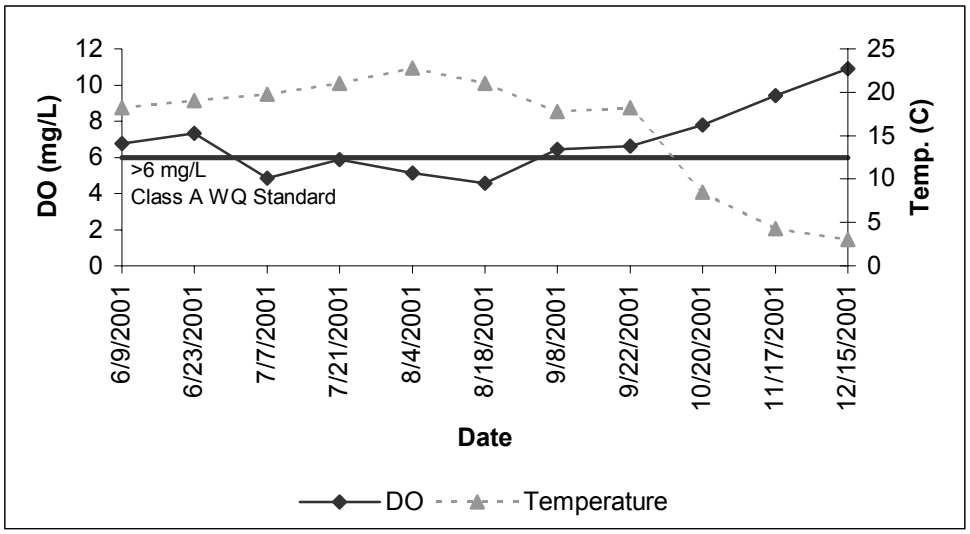


Figure 11. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 09-Oys, Gaging Station, Lee, NH. VRAP, Year 2000.

4.6.1.2. pH

The pH at this location ranged from 5.26 to 7.03. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurring*. The pH of surface waters can be affected by soil, subsurface

bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.6.1.3. *E. coli*

Figure 12 shows the instantaneous *E. coli* counts during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

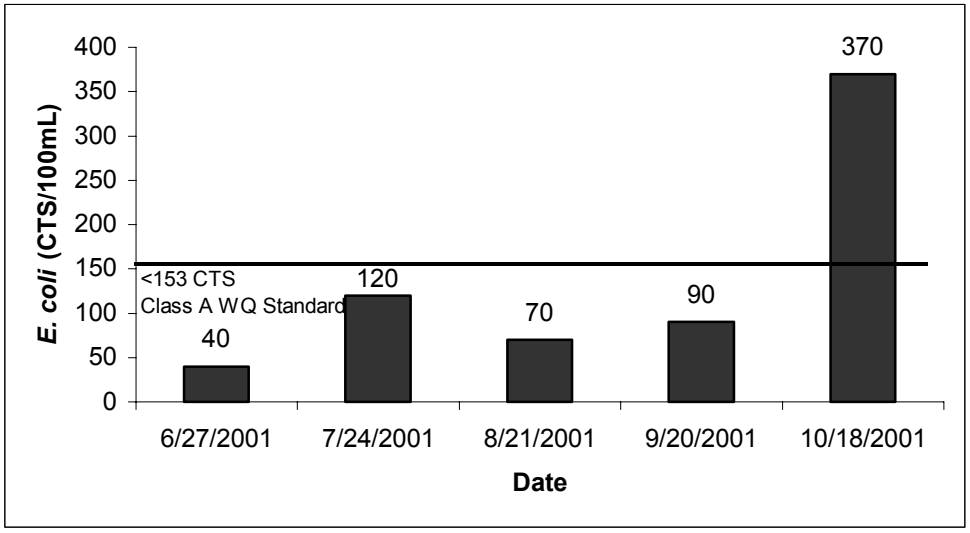


Figure 12. *E. coli* bacteria counts. Oyster River at 09-Oys, Gaging Station, Lee, NH. VRAP, Year 2001.

4.6.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

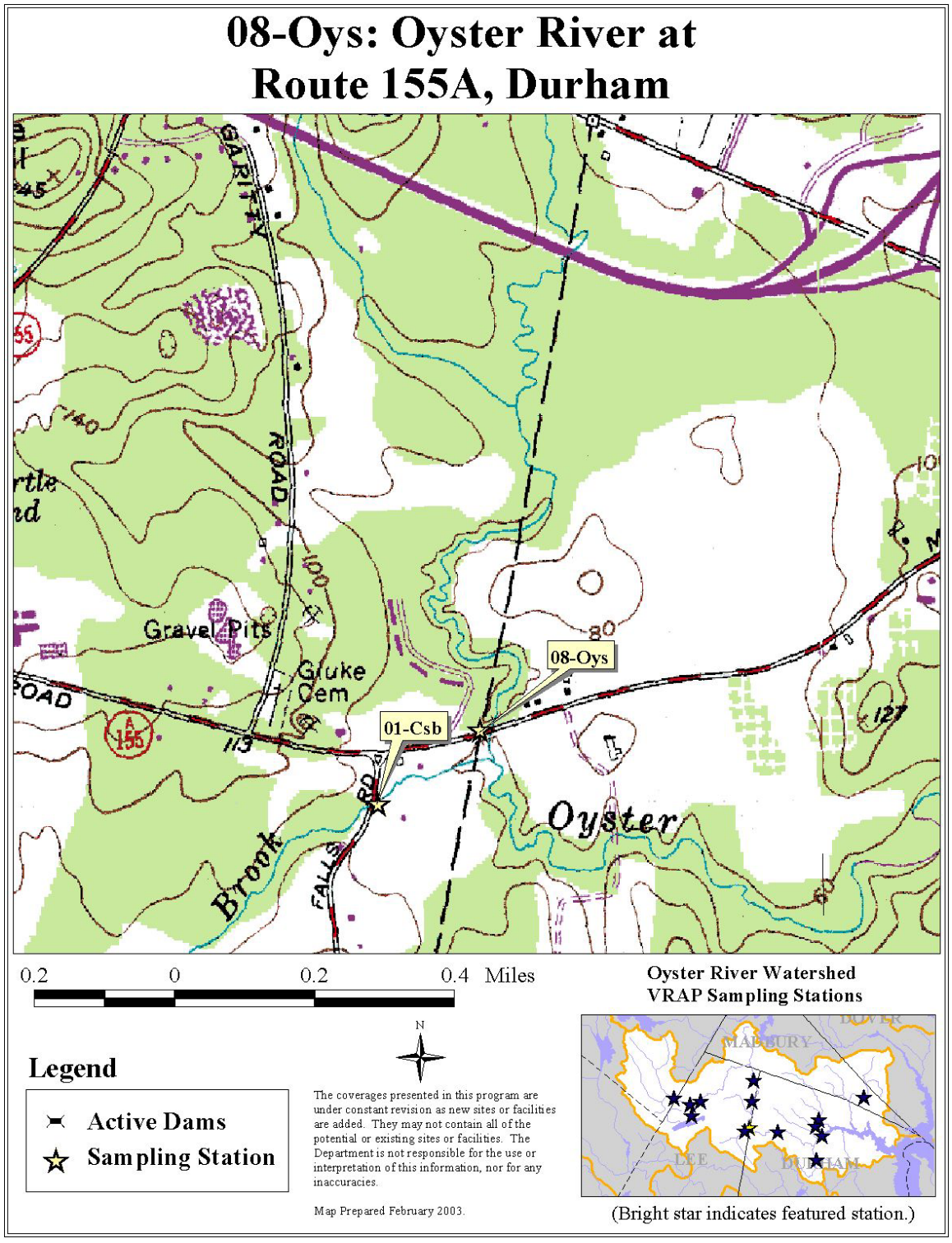
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to

determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.7. 08-Oys: Route 155A, Durham, NH



4.7.1. Results and Discussion

Fourteen measurements were made in the field for dissolved oxygen (DO) concentration and pH, 13 were made for DO % saturation, and 12 were made for turbidity and conductivity using handheld meters (Table 7). Five samples were collected for *E. coli* and several other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data do not show an apparent DO problem, although four of the DO % saturation measurements were below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.7.1.1, below). Four *E. coli* samples exceeded the instantaneous Class A water quality standard.

Table 7. Monitoring Summary: 08-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	6.58 - 10.71	**>6.0**
DO (% sat.)	13	13	7	67.4 - 83.2	**>75**
pH (std. units)	14	14	0	5.95 - 7.22	**naturally occuring**
Turbidity (NTU)	12	12	0	2.9 - 11.8	**naturally occuring**
Conductivity (µmho/cm)	12	12	0	147.1 - 301.3	**NA**
***E. coli* (CTS/100mL)**	5	5	4	90 - 360	**<153**
Calcium (mg/L)	5	5	0	26.16 - 60.03	**NA**
Chloride (mg/L)	5	5	0	0.075 - 0.367	**<860**
Magnesium (mg/L)	5	5	0	1 - 6	**NA**
Nitrate (mg/L)	5	5	0	0.87 - 2.46	**NA**
Nitrite (µg/L)	5	5	0	15.99 - 35.47	**NA**
Potassium (mg/L)	5	5	0	1.23 - 2.89	**NA**
Sodium (mg/L)	5	5	0	1.91 - 4.92	**NA**
Color (Color Units, 455 T)	5	5	0	60 - 220	**NA**
UV-254 (abs)	5	5	0	0.177 - 0.559	**NA**

Ammonia (µg/L)	5	5	0	3 - 66	*
Sulfate (mg/L)	5	5	0	0.87 - 2.46	**NA**
Phosphate (µg/L)	5	5	0	5 - 15	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.7.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 08-Oys were greater than the minimum instantaneous concentration of 6 mg/L (see Figure 13). However, the Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

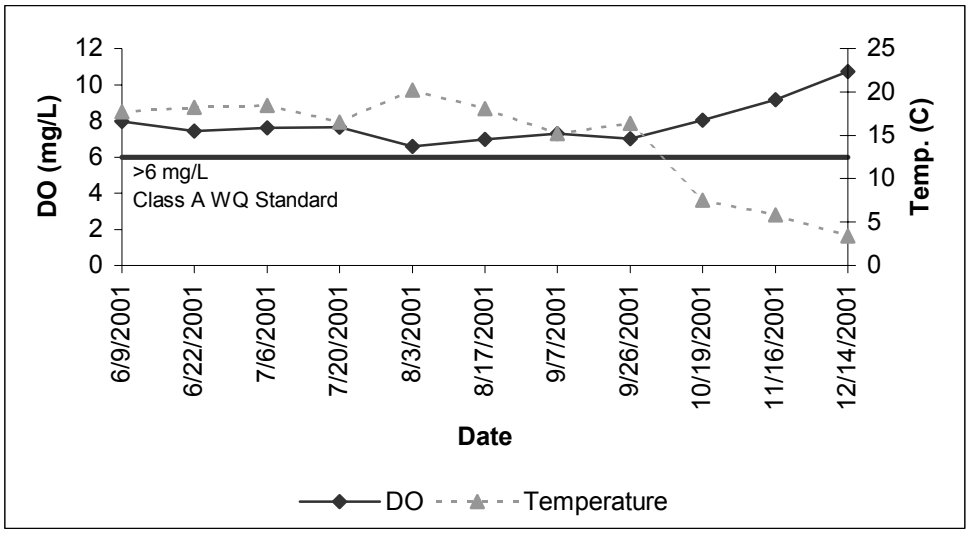


Figure 13. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 08-Oys, Route 155A, Durham, NH. VRAP, Year 2001.

4.7.1.2. pH

The pH at this location ranged from 5.95 to 7.22. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurs*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.7.1.3. *E. coli*

Figure 14 shows the instantaneous *E. coli* counts during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded four times. Additional sampling is necessary to determine the extent and magnitude of the problem.

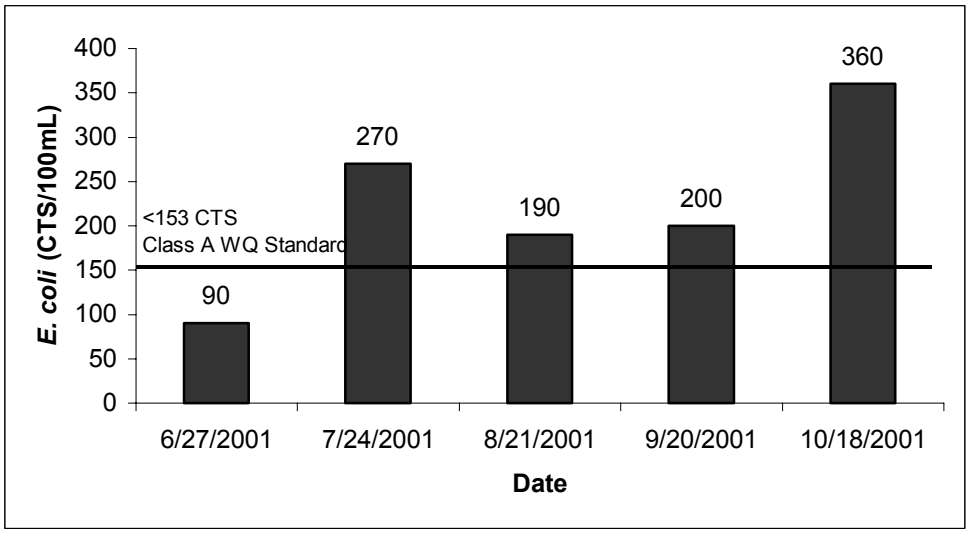


Figure 14. *E. coli* bacteria counts. Oyster River at 08-Oys, Route 155A, Durham, NH. VRAP, Year 2001.

4.7.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

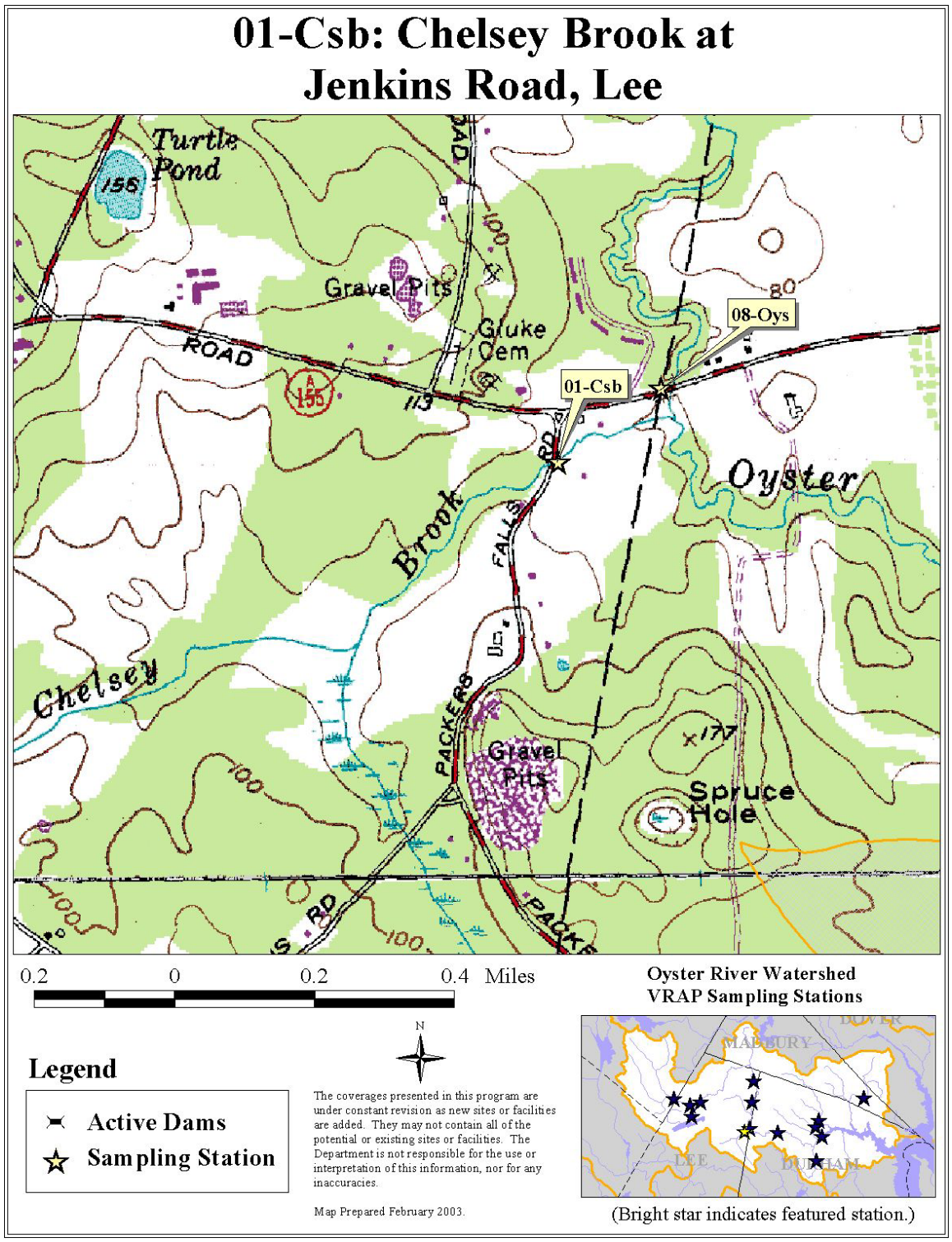
  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. Collecting samples at small intervals (as recommended for previous stations) is not recommended at this time, as four of the five stations experienced elevated *E. coli* counts. Volunteers should be document, in detail, the station conditions during the time of sampling.

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.8. 01-Csb: Jenkins Road, Lee, NH



4.8.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) concentration and pH, 12 were made for DO % saturation, 11 were made for turbidity, an 10 were made for conductivity using handheld meters (Table 8). Five samples were collected for *E. coli* bacteria and several other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data do not show an apparent DO problem, although two of the DO % saturation measurements were below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.8.1.1, below).

Table 8. Monitoring Summary: 01-Csb. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.68 - 10.49	**>6.0**
DO (% sat.)	12	12	2	74 - 98.2	**>75**
pH (std. units)	13	13	0	5.41 - 6.96	**naturally occuring**
Turbidity (NTU)	11	11	0	0 - 3.79	**naturally occuring**
Conductivity (µmho/cm)	10	10	0	134.8 - 252.2	**NA**
***E. coli* (CTS/100mL)**	5	5	0	<10 - 110	**<153**
Calcium (mg/L)	5	5	0	14.56 - 19.1	**NA**
Chloride (mg/L)	5	5	0	29.46 - 52.36	**<860**
Magnesium (mg/L)	5	5	0	3.53 - 4.54	**NA**
Nitrate (mg/L)	5	5	0	0.03 - 1.947	**NA**
Nitrite (µg/L)	5	5	0	5-Feb	**NA**
Potassium (mg/L)	5	5	0	1.44 - 2.87	**NA**
Sodium (mg/L)	5	5	0	15.29 - 17.9	**NA**
Color (Color Units, 455 T)	5	5	0	4 - 120	**NA**
UV-254 (abs)	5	5	0	0.036 - 0.501	**NA**

Ammonia (µg/L)	5	5	0	23-Mar	*
Sulfate (mg/L)	5	5	0	2.54 - 5.81	**NA**
Phosphate (µg/L)	5	5	0	17-Sep	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.8.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 01-Csb were greater than the minimum instantaneous concentration of 6 mg/L (see Figure 15). However, the Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

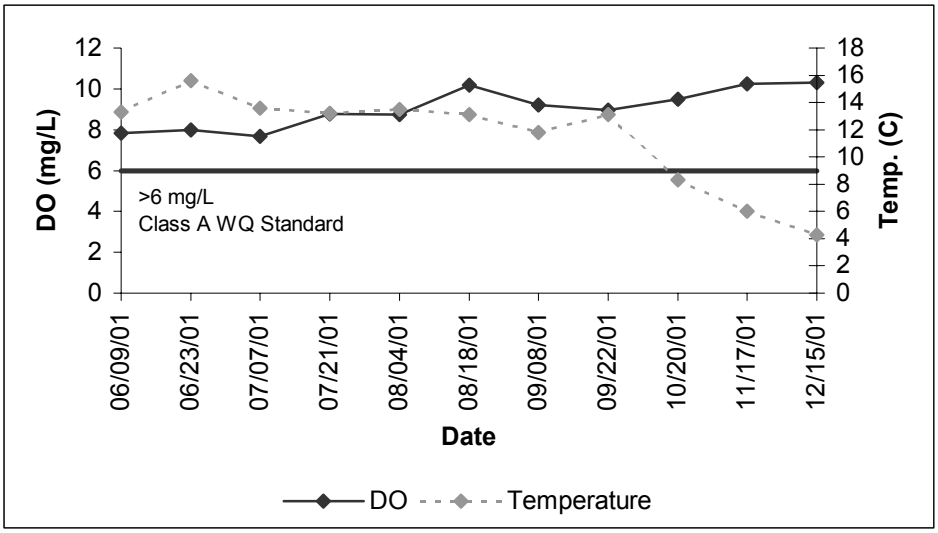


Figure 15. Dissolved Oxygen (DO) Concentration vs. Temperature. Chelsey Brook, at 01-Csb, Jenkins Road, Lee, NH. VRAP, Year 2001.

4.8.1.2. pH

The pH at this location ranged from 5.41 to 6.96. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be as naturally occurs*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.8.1.3. *E. coli*

Figure 16 shows the instantaneous *E. coli* counts during summer and early fall 2001.

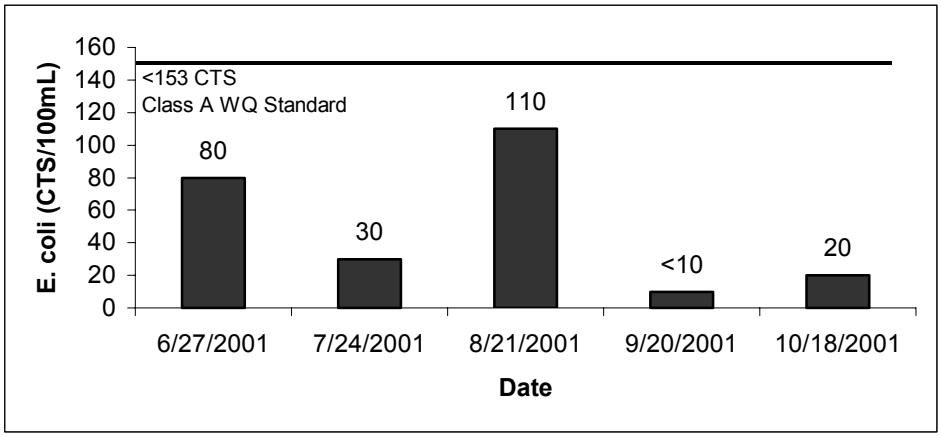


Figure 16. *E. coli* bacteria counts. Oyster River at 01-Csb, Jenkins Road, Lee, NH. VRAP, Year 2001.

4.8.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

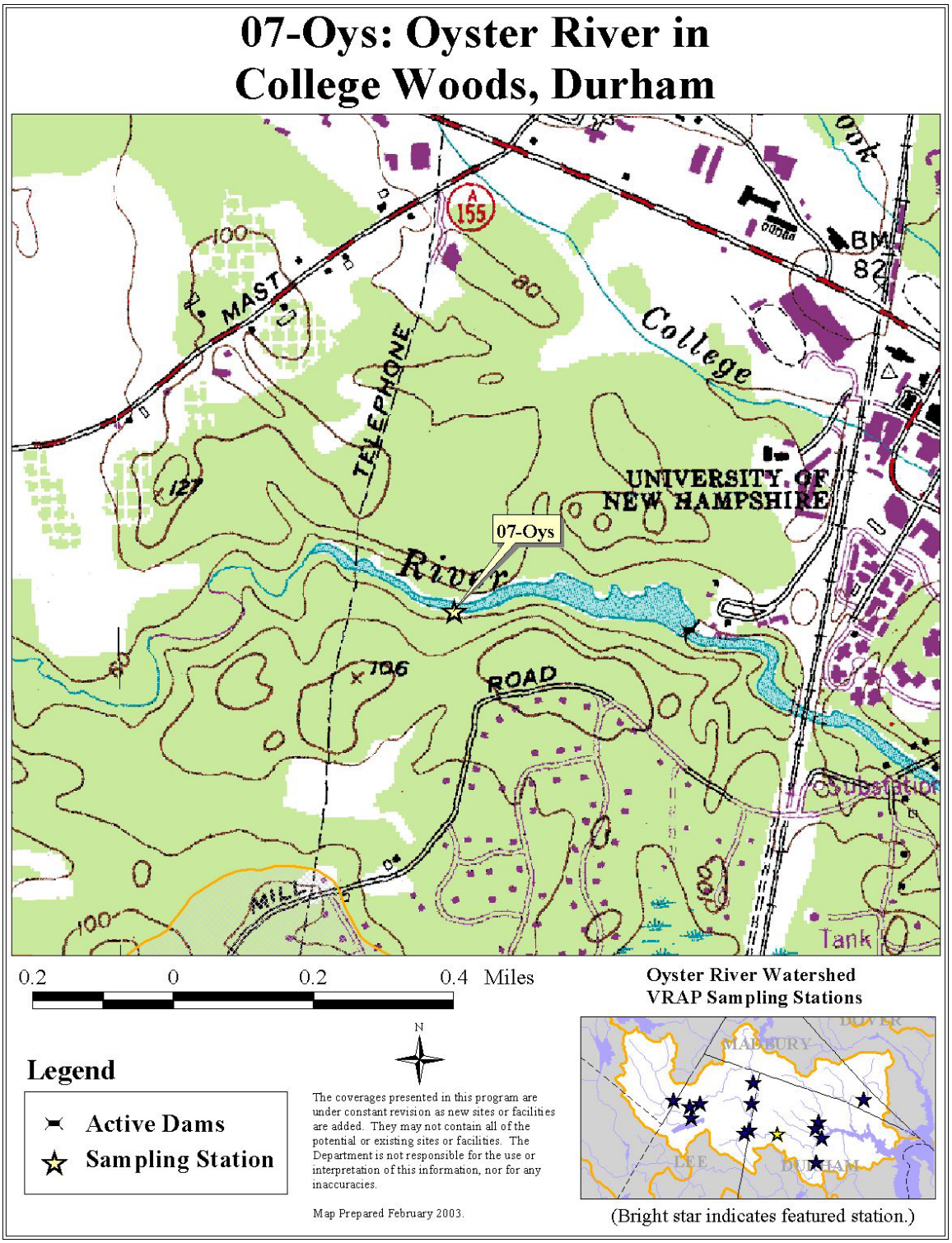
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a

multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.9. 07-Oys: College Woods, Durham, NH



4.9.1. Results and Discussion

Fourteen measurements were made in the field dissolved oxygen (DO) and pH, and 13 were made for turbidity and conductivity using handheld meters (Table 9). Five samples were collected for *E. coli* bacteria, and several samples were collected for various other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. The DO concentration data do not show an apparent DO problem, although eight of the DO % saturation measurements were below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.9.1.1, below). One *E. coli* sample exceeded the Class A instantaneous water quality standard.

Table 9. Monitoring Summary: 07-Oys. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	6.23 - 11.05	**>6.0**
DO (% sat.)	14	14	8	65.4 - 80.4	**>75**
pH (std. units)	14	14	0	6.07 - 7.01	**naturally occuring**
Turbidity (NTU)	13	13	0	2.5 - 14	**naturally occuring**
Conductivity (μmho/cm)	13	13	0	151 - 279.6	**NA**
***E. coli* (CTS/100mL)**	5	5	1	30 - 340	**<153**
MTBE	3	3	0	undetected	
Calcium (mg/L)	5	5	0	10.46 - 16.31	**NA**
Chloride (mg/L)	5	5	0	30.35 - 48.75	**<860**
Magnesium (mg/L)	5	5	0	2.57 - 4.43	**NA**
Nitrate (mg/L)	5	5	0	0.111 - 0.422	**NA**
Nitrite (μg/L)	5	5	0	2 - 9	**NA**
Potassium (mg/L)	5	5	0	1.54 - 3.27	**NA**
Sodium (mg/L)	5	5	0	18.88 - 28.39	**NA**

Color (Color Units, 455 T)	5	5	0	65 - 160	**NA**
UV-254 (abs)	5	5	0	0.22 - 0.533	**NA**
Ammonia (µg/L)	5	5	0	4 - 59	*
Sulfate (mg/L)	5	5	0	1.37 - 3.11	**NA**
Phosphate (µg/L)	5	5	0	4 - 11	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.9.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 07-Oys were greater than the minimum instantaneous concentration of 6 mg/L (see Figure 17). However, the Class A New Hampshire surface water quality standard for DO is a minimum concentration of 6.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

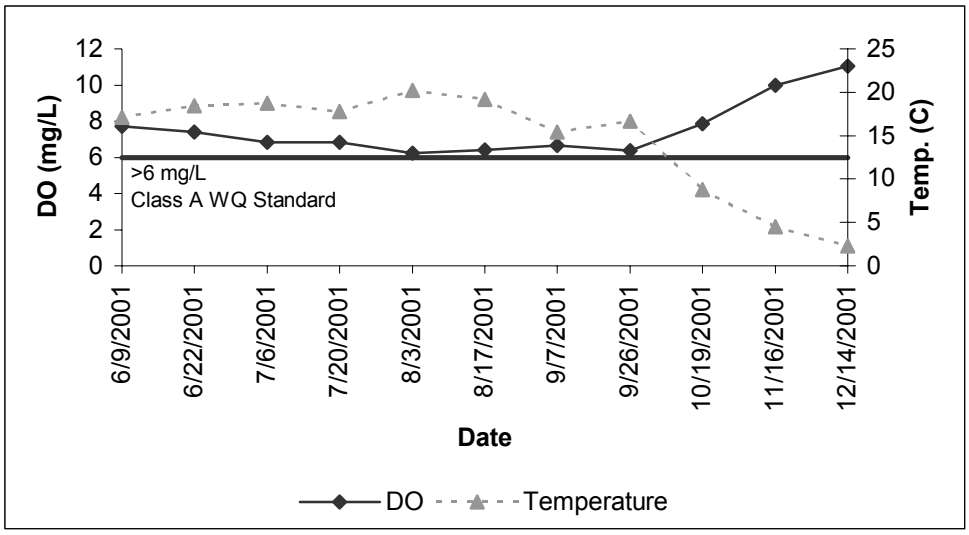


Figure 17. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 07-Oys, College Woods, Durham, NH. VRAP, Year 2001.

4.9.1.2. pH

The pH at this location ranged from 6.07 to 7.01. Station conditions are considered along with pH measurements because of the narrative pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class A waters *shall be*

as naturally occurs. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.9.1.3. *E. coli*

Figure 18 shows the instantaneous *E. coli* counts during summer and early fall 2001. The Class A surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

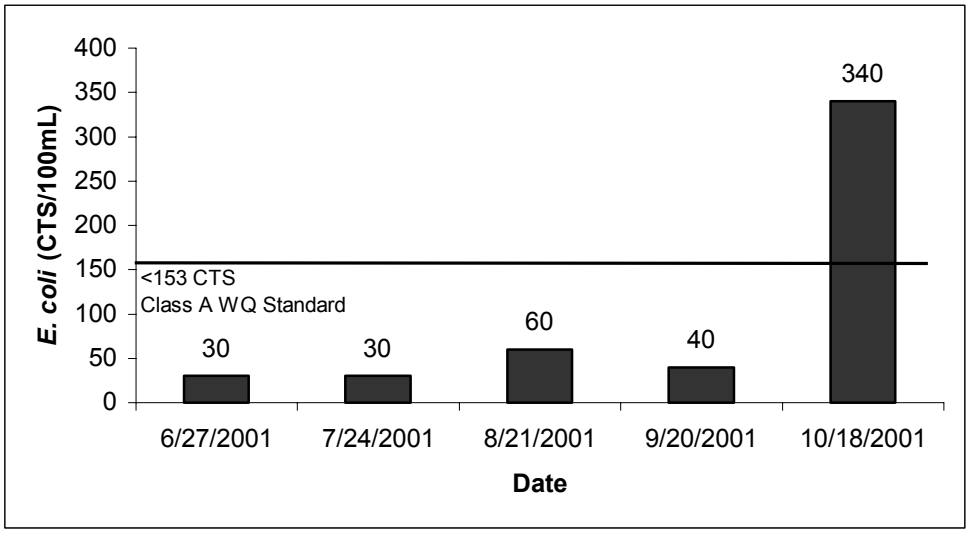


Figure 18. *E. coli* bacteria counts. Oyster River at 07-Oys, College Woods, Durham, NH. VRAP, Year 2001.

4.9.2. Recommendations:

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

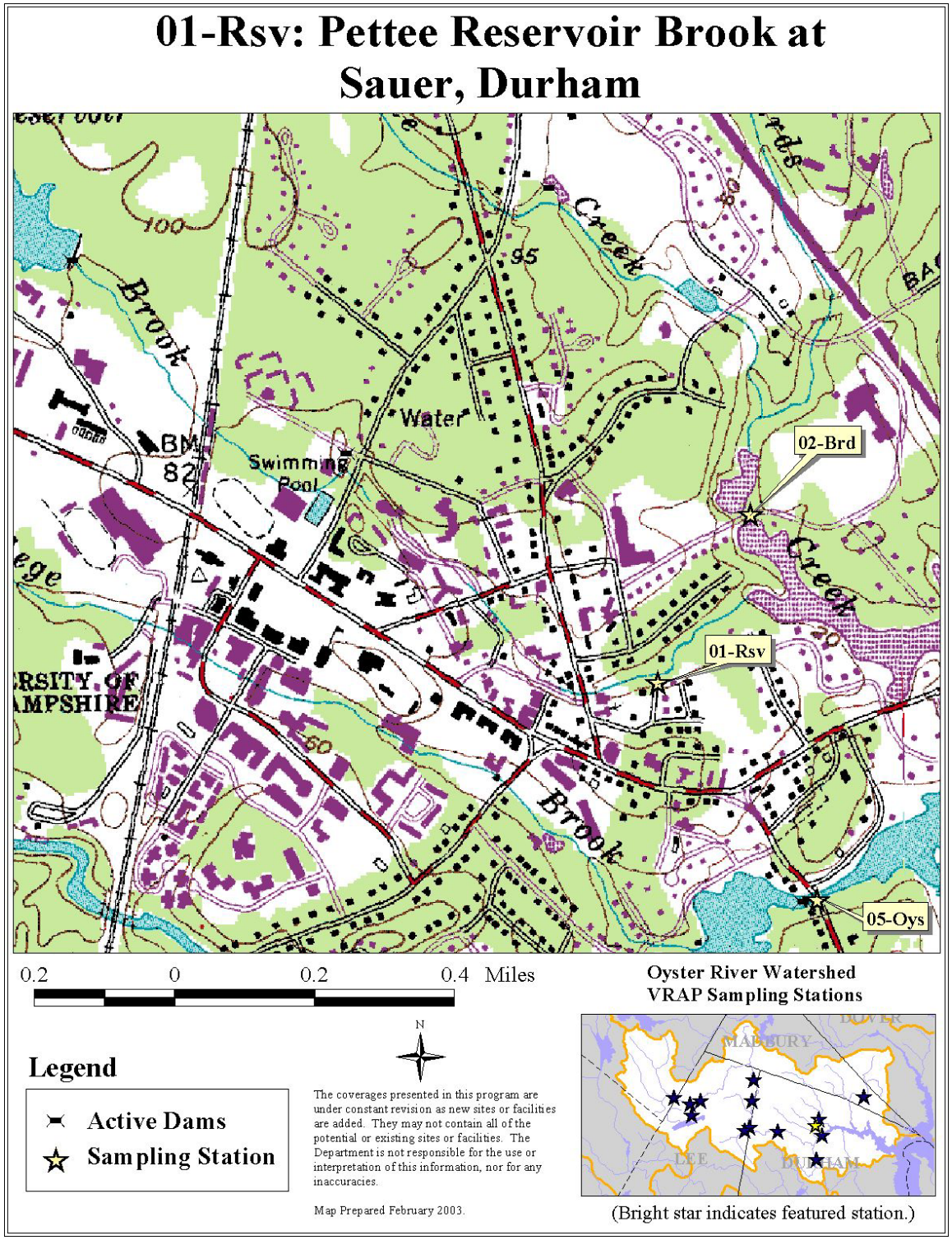
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue

to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.10. 01-Rsv: Pettee Reservoir Brook at Sauer, Durham, NH



4.10.1. Results and Discussion

Twelve measurements were made in the field for dissolved oxygen (DO) and pH, and eleven made for turbidity and conductivity using handheld meters (Table 10). Five samples were collected for *E. coli* bacteria, and several samples were collected for various other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. One pH measurement was below the Class B water quality standard. The DO concentration data do not show an apparent DO problem, although one of the DO % saturation measurements was below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.10.1.1, below). Two *E. coli* samples exceeded the instantaneous Class B water quality standard.

Table 10. Monitoring Summary: 01-Rsv. VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	12	12	0	7.01 - 10.99	**>5**
DO (% sat.)	12	12	1	61.8 - 97.3	**>75**
Turbidity (NTU)	11	11	0	0.8 - 20	**<10 above background**
pH (std. units)	12	12	3	5.83 - 7.38	**6.5-8.0**
Conductivity (μmho/cm)	11	11	0	277.3 - 1759	**NA**
***E. coli* (CTS/100mL)**	5	5	2	<10 - 650	**<406**
Calcium (mg/L)	5	5	0	16.39 - 56.89	**NA**
Chloride (mg/L)	5	5	0	69.92 - 118.31	**<860**
Magnesium (mg/L)	5	5	0	2.78 - 12.47	**NA**
Nitrate (mg/L)	5	5	0	0 - 1.294	**NA**
Nitrite (μg/L)	5	5	0	1 - 15	**NA**
Potassium (mg/L)	5	5	0	2.87 - 10.8	**NA**
Sodium (mg/L)	5	5	0	41.85 - 295.09	**NA**

Color (Color Units, 455 T)	5	5	0	18 - 90	**NA**
UV-254 (abs)	4	4	0	0.096 - 0.465	**NA**
Ammonia (µg/L)	5	5	0	11 - 96	*
Sulfate (mg/L)	5	5	0	2.16 - 4.54	**NA**
Phosphate (µg/L)	5	5	0	9 - 41	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.10.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 01-Rsv were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 19). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

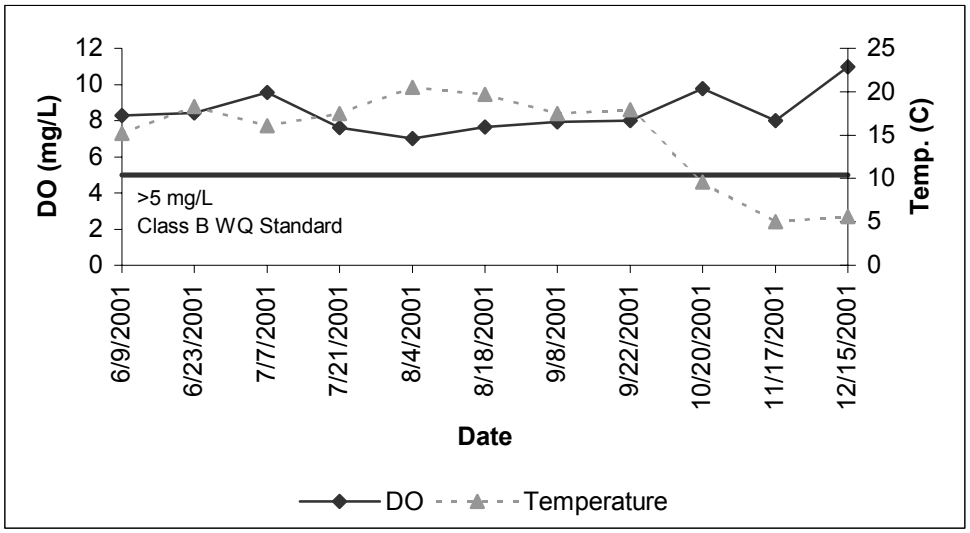


Figure 19. Dissolved Oxygen (DO) Concentration vs. Temperature. Pettee Reservoir Brook @ Sauer, 01-Rsv, Durham, NH. VRAP, Year 2001.

4.10.1.2. pH

The pH at this location, ranging from 5.83 to 7.38, was measured below the state standard on three of 12 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B

waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.10.1.3. *E. coli*

Figure 20 shows the instantaneous *E. coli* counts during summer and fall 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded twice. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

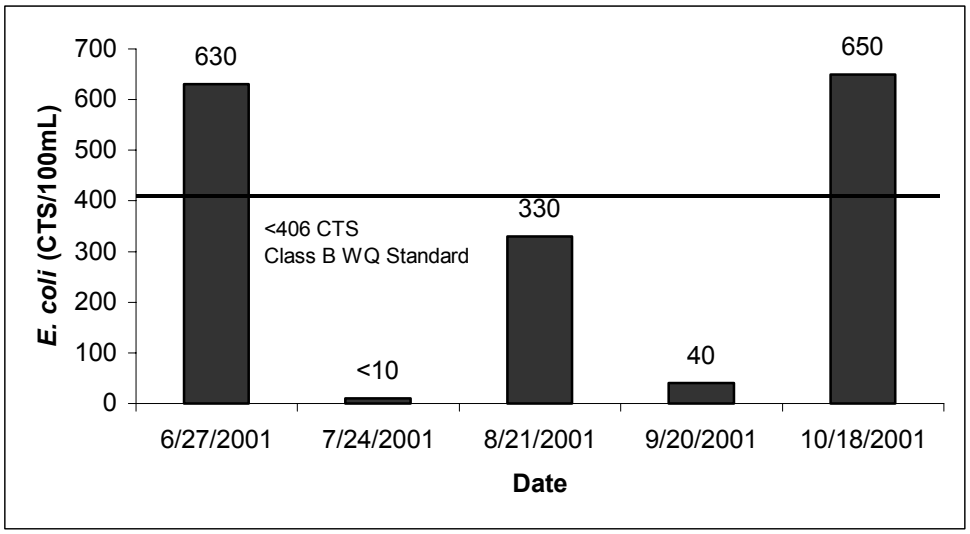


Figure 20. *E. coli* Bacteria Counts. Pettee Reservoir Brook @ Sauer, 01-Rsv, Durham, NH. VRAP, Year 2001.

4.10.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

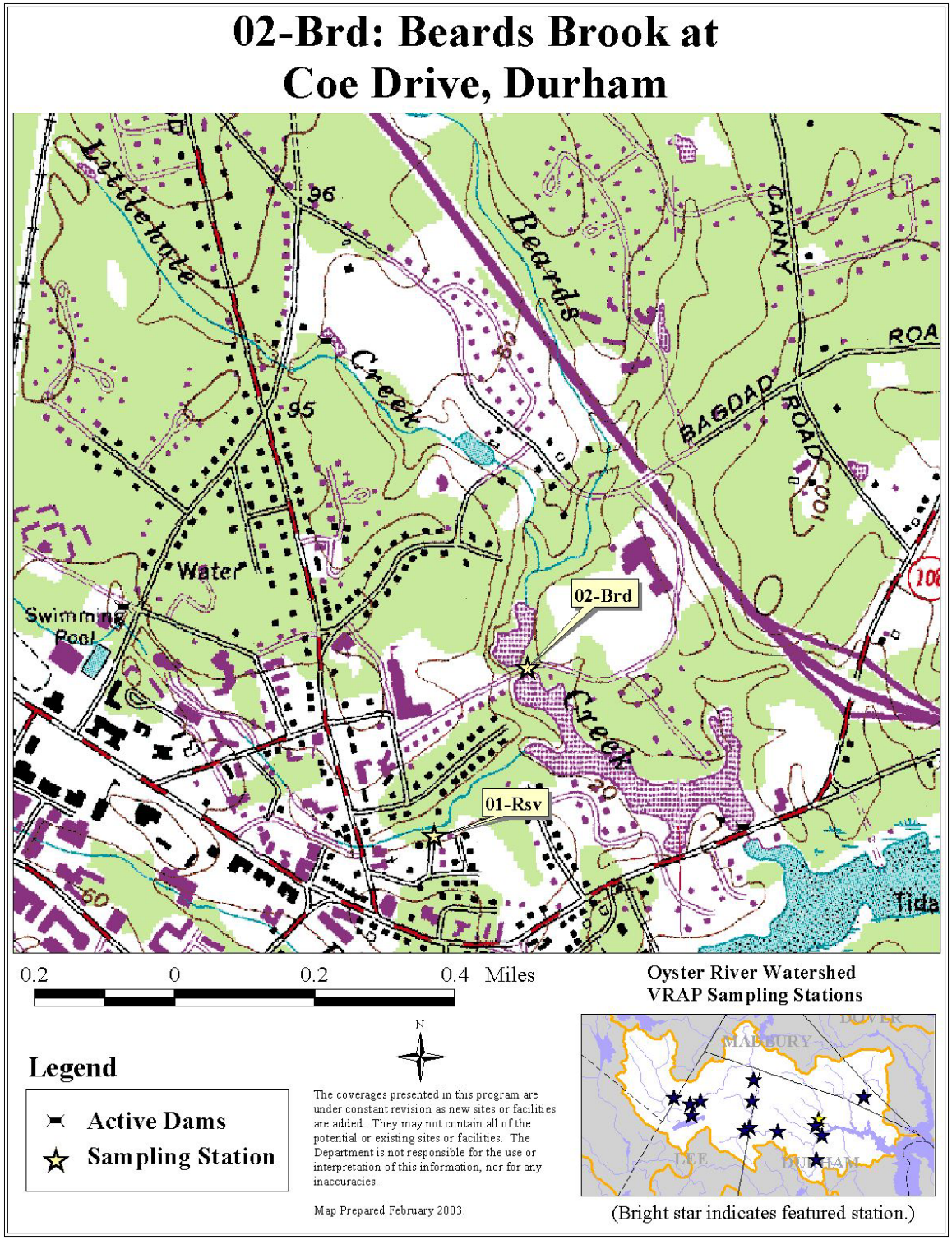
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to

determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.11. 02-Brd: Coe Drive, Durham, NH



4.11.1. Results and Discussion

Fourteen measurements were made in the field for dissolved oxygen (DO) and pH, and 12 were made for turbidity and conductivity using handheld meters (Table 11). Five samples were collected for *E. coli* bacteria, and several were collected for other parameters. Nearly all field measurements and the *E. coli* samples met the Quality Assurance and Quality Control (QA/QC) requirements. Seven pH measurements were below the Class B water quality standard. The DO concentration data show an apparent DO problem, although it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.11.1.1, below). Three *E. coli* samples exceeded the instantaneous Class B water quality standard.

Table 11. Monitoring Summary: 02-Brd, VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	13	7	1.17 - 10.05	**>5**
DO (% sat.)	14	14	14	13.7 - 69	**>75**
pH (std. units)	14	13	7	5.47 - 6.84	**6.5-8.0**
Turbidity (NTU)	12	12	0	5.6 - 16	**<10 above background**
Conductivity (µmho/cm)	12	11	0	326.6 - 439	**NA**
***E. coli* (CTS/100mL)**	5	5	3	140 - >2000	**<406**
Calcium (mg/L)	5	5	0	16.46 - 25.81	**NA**
Chloride (mg/L)	5	5	0	52.85 - 72.17	**<860**
Magnesium (mg/L)	5	5	0	3.67 - 6.06	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.162	**NA**
Nitrite (ug/L)	5	5	0	1 - 8	**NA**
Potassium (mg/L)	5	5	0	3.36 - 4.79	**NA**
Sodium (mg/L)	5	5	0	26.67 - 42.9	**NA**
Color (Color Units, 455 T)	5	5	0	68 - 180	**NA**

UV-254 (abs)	5	5	0	0.221 - 0.299	**NA**
Ammonia (µg/L)	5	5	0	30 - 156	*
Sulfate (mg/L)	5	5	0	1.32 - 4.17	**NA**
Phosphate (µg/L)	5	5	0	2 - 9	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

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4.11.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 02-Brd were, on several occasions, less than the minimum instantaneous concentration of 5 mg/L (see Figure 21). The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

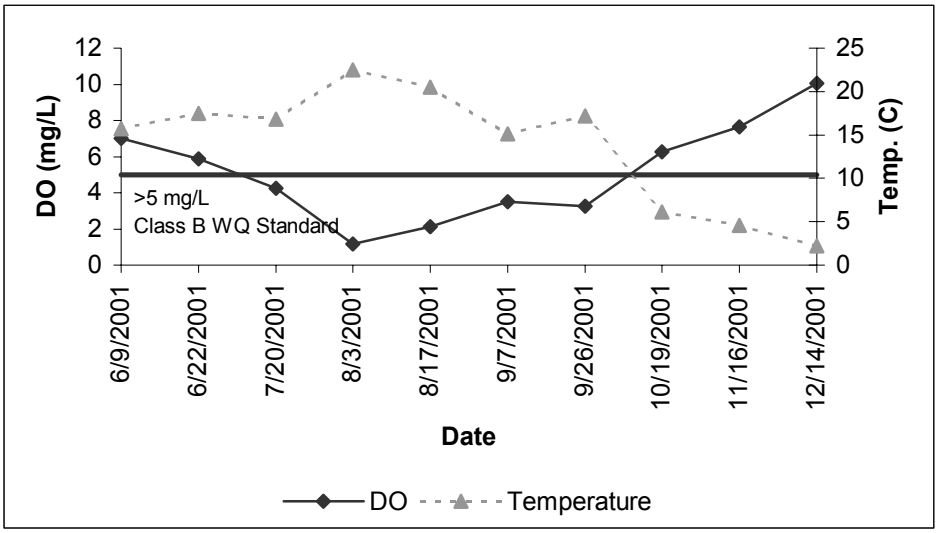


Figure 21. Dissolved Oxygen (DO) Concentration vs. Temperature. Beards Brook @ 02-Brd, Coe Drive, Durham, NH. VRAP, Year 2001.

4.11.1.2. pH

The pH at this location, ranging from 5.47 to 6.84, was measured below the state standard on seven of 13 occasions. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of

surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.11.1.3. *E. coli*

Figure 22 shows the instantaneous *E. coli* counts during summer and fall 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded three times. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

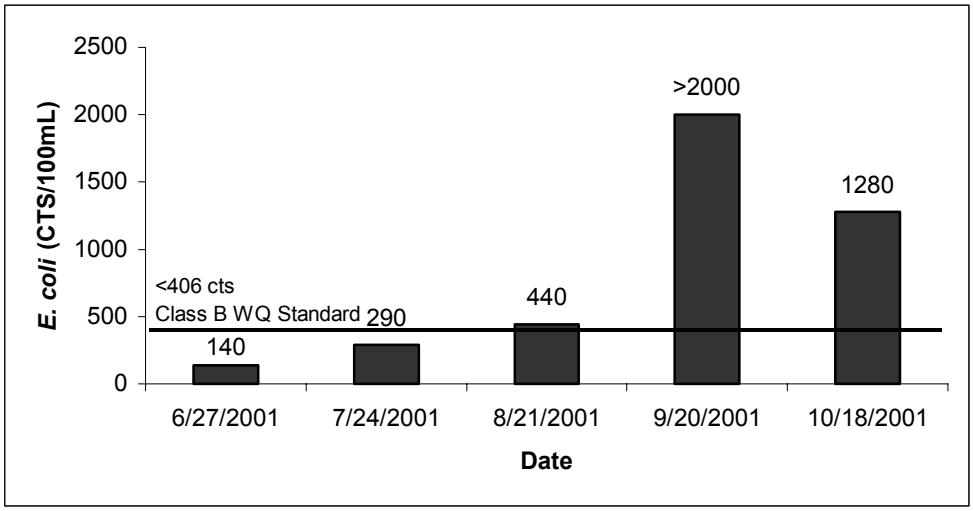


Figure 22. *E. coli* Bacteria Counts. Beards Brook @ 02-Brd, Coe Drive, Durham, NH. VRAP, Year 2001.

4.11.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

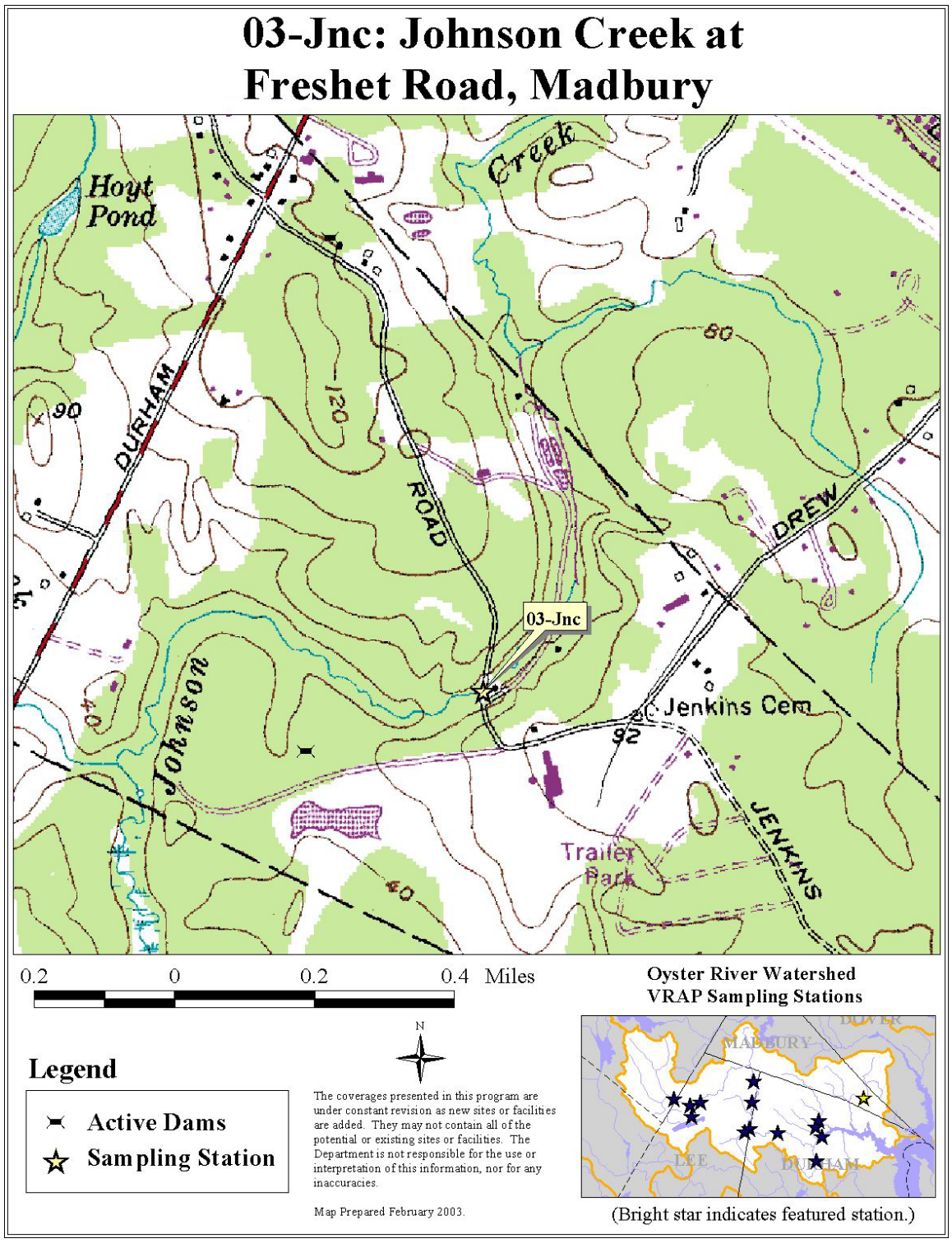
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average

that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.12. 03-Jnc: Freshet Road, Madbury, NH



4.12.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) and pH, and eleven measurements were made for turbidity and conductivity using handheld meters (Table 12). Five samples were collected for *E. coli* bacteria and various other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Three pH measurements were below the Class B surface water quality standards. The DO concentration data do not show any apparent DO problems. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.12.1.1, below).

Table 12. Monitoring Summary: 03-Jnc. VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.86 - 11.86	**>5**
DO (% sat.)	13	13	0	85 - 98.6	**>75**
pH (std. units)	13	13	3	4.83 - 7.61	**6.5-8.0**
Turbidity (NTU)	11	11	0	1.5 - 14	**<10 above background**
Conductivity (µmho/cm)	11	11	0	183 - 383.8	**NA**
***E. coli* (CTS/100mL)**	5	5	0	50 - 320	**<406**
Calcium (mg/L)	5	5	0	10.78 - 14.98	**NA**
Chloride (mg/L)	5	5	0	45.04 - 59.97	**<860**
Magnesium (mg/L)	5	5	0	2.43 - 3.45	**NA**
Nitrate (mg/L)	5	5	0	0.153 - 0.343	**NA**
Nitrite (µg/L)	5	5	0	2 - 10	**NA**
Potassium (mg/L)	5	5	0	2.18 - 4.84	**NA**
Sodium (mg/L)	5	5	0	26.93 - 37.03	**NA**
Color (Color Units, 455 T)	5	5	0	59 - 165	**NA**
UV-254 (abs)	5	5	0	0.241 - 0.555	**NA**

Ammonia (µg/L)	5	5	0	7 - 71	*
Sulfate (mg/L)	5	5	0	1.69 - 6.21	**NA**
Phosphate (µg/L)	5	5	0	6 - 10	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.12.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 03-Jnc were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 23). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

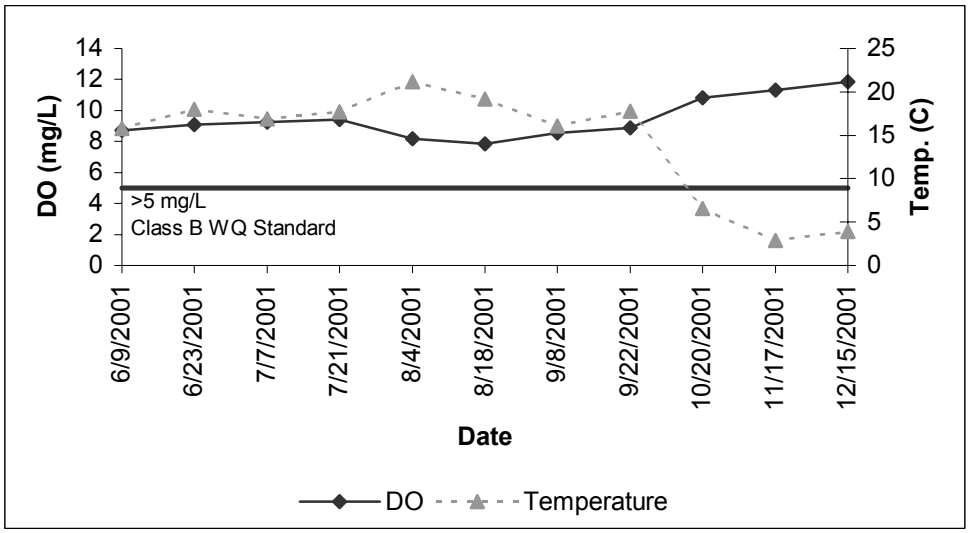


Figure 23. Dissolved Oxygen (DO) Concentration vs. Temperature. Johnson Creek at 03-Jnc, Freshet Road, Madbury, NH. VRAP, Year 2001.

4.12.1.2. pH

The pH at this location, ranging from 4.83 to 7.61, was measured below the state standard on three of 13 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.12.1.3. *E. coli*

Figure 24 shows the instantaneous *E. coli* counts during summer 2001.

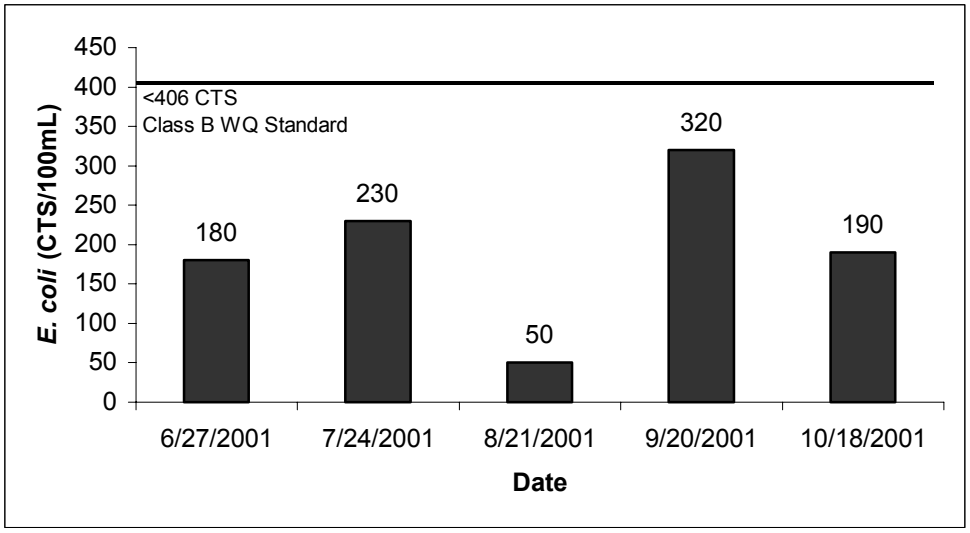


Figure 24. *E. coli* Bacteria Counts. Johnson Creek at 03-Jnc, Freshet Road, Madbury, NH. VRAP, Year 2001.

4.12.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

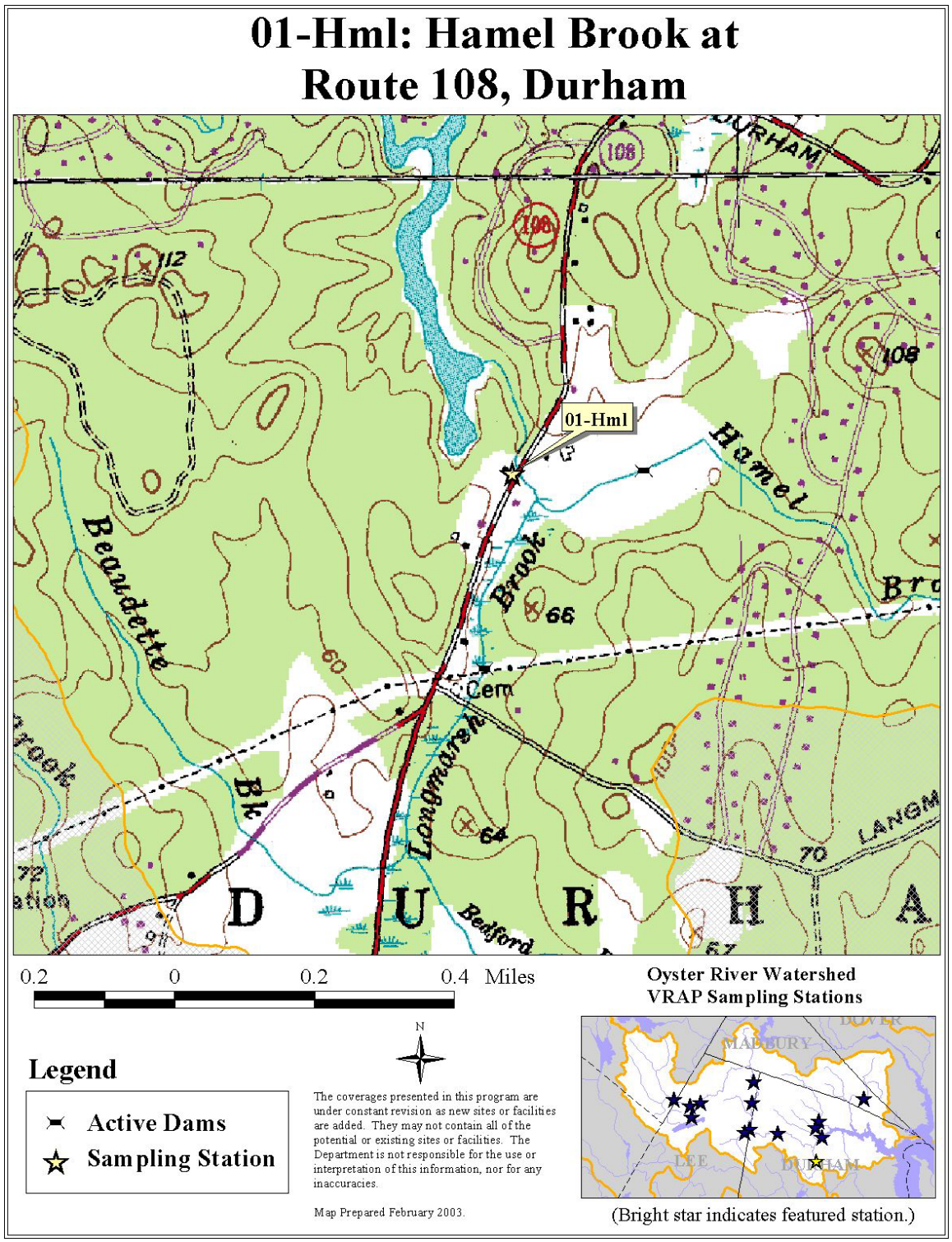
- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.

- *Dissolved Oxygen*: Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met

before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.13. 01-Hml: Route 108, Durham, NH



4.13.1. Results and Discussion

Thirteen measurements were made in the field for dissolved oxygen (DO) and pH, and 12 measurements were made for turbidity and conductivity using handheld meters (Table 13). Five samples were collected for *E. coli* bacteria and several other parameters. Twelve of 13 DO concentration, pH, turbidity, and conductivity measurements met the Quality Assurance and Quality Control (QA/QC) requirements. All DO % saturation measurements and all *E. coli* samples met these requirements. Ten pH measurements were below the Class B surface water quality standards. The DO concentration data show an apparent DO problem. However, it should be noted that these data alone do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.13.1.1, below). Two *E. coli* samples exceeded the Class B surface water quality standard.

Table 13. Monitoring Summary: 01-Hml. VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	12	5	3.66 - 9.69	**>5**
DO (% sat.)	13	13	13	35 - 71.3	**>75**
pH (std. units)	13	12	10	5.9 - 7.26	**6.5-8.0**
Turbidity (NTU)	12	12	0	2 - 9.66	**<10 above background**
Conductivity (µmho/cm)	12	12	0	174 - 428.2	**NA**
***E. coli* (CTS/100mL)**	5	5	2	60 - >2000	**<406**
Calcium (mg/L)	5	5	0	15.71 - 33.23	**NA**
Chloride (mg/L)	5	5	0	24.84 - 67.34	**<860**
Magnesium (mg/L)	5	5	0	2.79 - 6.29	**NA**
Nitrate (mg/L)	5	5	0	0.128 - 0.286	**NA**
Nitrite (µg/L)	5	5	0	3 - 14	**NA**
Potassium (mg/L)	5	5	0	2.16 - 6.03	**NA**
Sodium (mg/L)	5	5	0	13.83 - 33.23	**NA**

Color (Color Units, 455 T)	5	5	0	47 - 160	**NA**
UV-254 (abs)	5	5	0	0.166 - 0.539	**NA**
Ammonia (µg/L)	5	5	0	22 - 80	*
Sulfate (mg/L)	5	5	0	1.11 - 7.22	**NA**
Phosphate (µg/L)	5	5	0	8 - 12	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.13.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 01-Hml were, on several occasions, less than the minimum instantaneous concentration of 6 mg/L (see Figure 25). The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. However, the low DO concentrations suggest a possible problem, or may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam). An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling and a thorough description of this station are necessary to determine the extent of the potential problem.

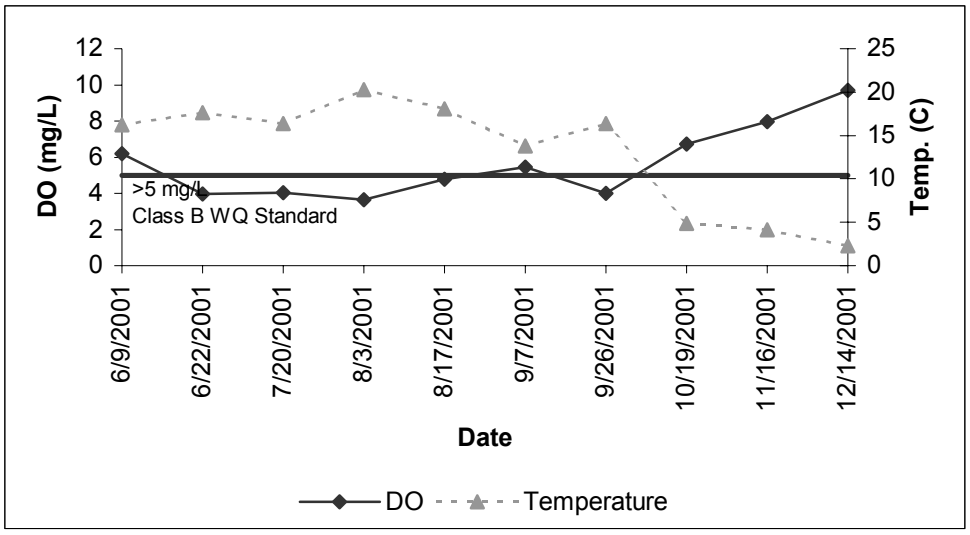


Figure 25. Dissolved Oxygen (DO) Concentration vs. Temperature. Hamel Brook at 01-Hml, Route 108, Durham, NH. VRAP, Year 2001.

4.13.1.2. pH

The pH at this location, ranging from 5.90 to 7.26, was measured below the state standard on ten of 13 monitoring dates. Station conditions are considered along with pH

measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.13.1.3. *E. coli*

Figure 26 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded twice. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

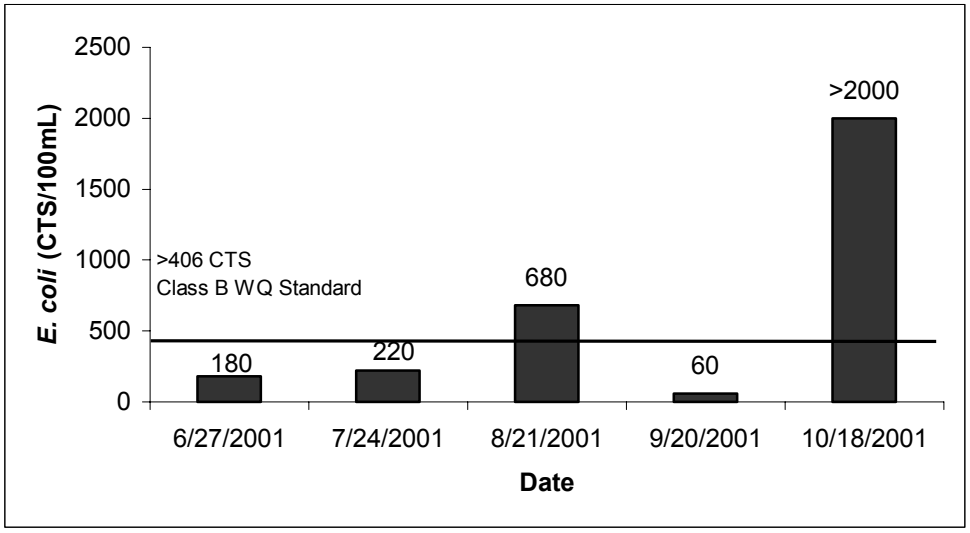


Figure 26. *E. coli* Bacteria Counts. Hamel Brook at 01-Hml, Route 108, Durham, NH. VRAP, Year 2001.

4.13.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

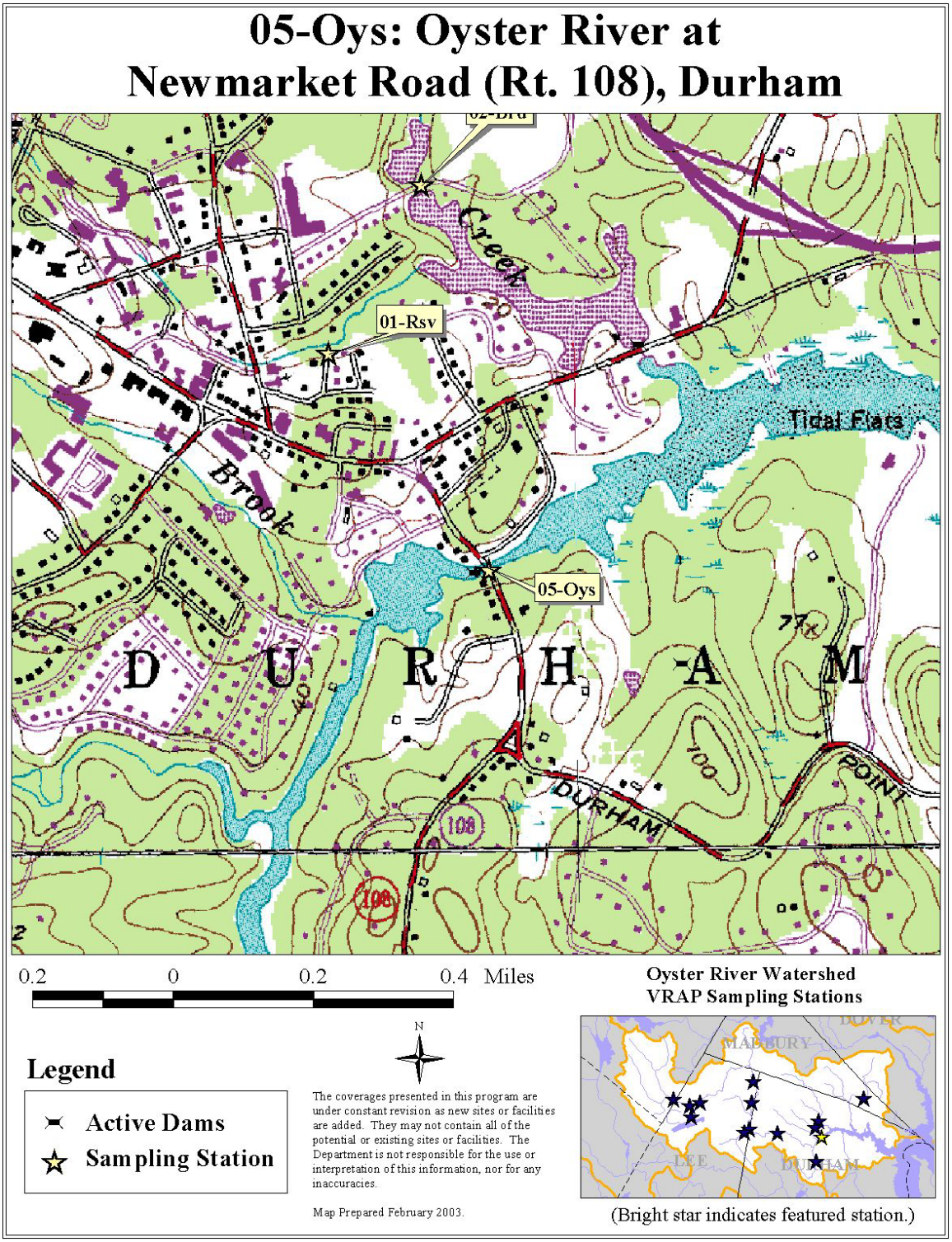
  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.14. 05-Oys: Newmarket Road, Durham, NH



4.14.1. Results and Discussion

Twelve measurements were made in the field for dissolved oxygen (DO), pH, and conductivity, and four were made for turbidity using handheld meters (Table 14). Five samples were collected for *E. coli* bacteria, and several samples were collected for various other parameters. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Two pH measurements were below the Class B surface water quality standard. The DO concentration data do not show an apparent DO problem, although five of the DO % saturation measurements were below 75%. It should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation in Section 4.14.1.1, below). One *E. coli* sample exceeded the instantaneous Class B water quality standard.

Table 14. Monitoring Summary: 05-Oys. VRAP, Year 2001

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	12	12	0	5.9 - 10.04	**>5**
DO (% sat.)	12	12	5	66.3 - 110.3	**>75**
Turbidity (NTU)	11	11	0	2.1 - 24.2	**<10 above background**
pH (std. units)	12	12	2	5.4 - 7.78	**6.5-8.0**
Conductivity (µmho/cm)	12	12	0	187.1 - 370	**NA**
***E. coli* (CTS/100mL)**	5	5	1	10 - 720	**<406**
Calcium (mg/L)	5	5	0	11.94 - 20.47	**NA**
Chloride (mg/L)	5	5	0	33.2 - 69.35	**<860**
Magnesium (mg/L)	5	5	0	2.5 - 4.95	**NA**
Nitrate (mg/L)	5	5	0	0 - 0.283	**NA**
Nitrite (µg/L)	5	5	0	0 - 9	**NA**
Potassium (mg/L)	5	5	0	1.81 - 3.62	**NA**
Sodium (mg/L)	5	5	0	19.52 - 37.79	**NA**
Color (Color Units, 455 T)	4	4	0	43 - 70	**NA**

UV-254 (abs)	4	4	0	0.158 - 0.264	**NA**
Ammonia (µg/L)	5	5	0	3 - 76	*
Sulfate (mg/L)	5	5	0	1.42 - 2.7	**NA**
Phosphate (µg/L)	5	5	0	6 - 12	**NA**

***Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.**

4.14.1.1. Dissolved Oxygen

Dissolved oxygen concentrations in the river at 05-Oys were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 27). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

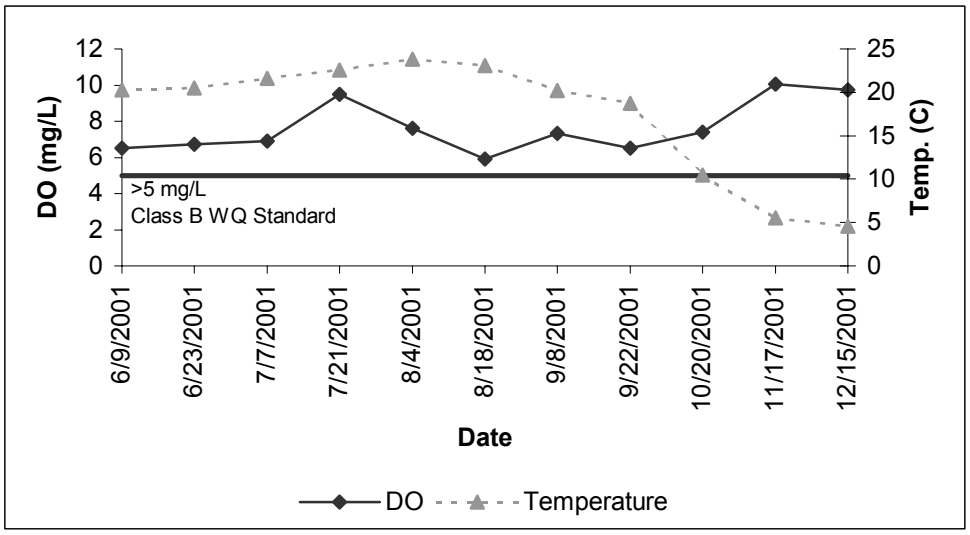


Figure 27. Dissolved Oxygen (DO) Concentration vs. Temperature. Oyster River at 05-Oys, Newmarket Road, Durham, NH. VRAP, Year 2001.

4.14.1.2. pH

The pH at this location, ranging from 5.40 to 7.78, was measured below the state standard on two of 12 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or

stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

4.14.1.3. *E. coli*

Figure 28 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded twice. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

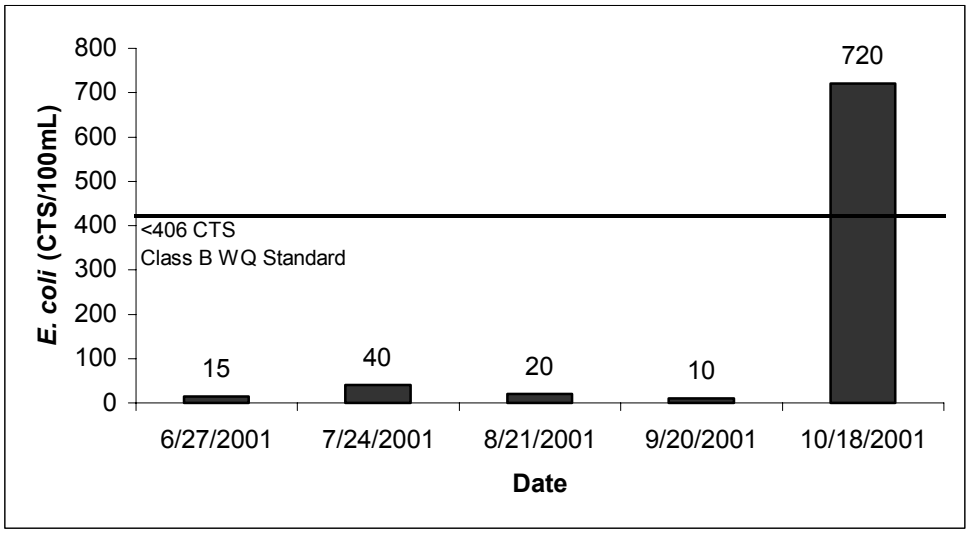


Figure 28. *E. coli* Bacteria Counts. Oyster River at 05-Oys, Newmarket Road, Durham, NH. VRAP, Year 2001.

4.14.2. Recommendations

- *Baseline Monitoring*: Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

  For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average

that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).

- *Dissolved Oxygen***:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

Appendix A:

Oyster River VRAP 2001
Monitoring Stations

Appendix B:

Oyster River VRAP 2001
Monitoring Results

Appendix C:

VRAP 2001 Parameter Descriptions and NH Surface Water Quality Standards

Appendix D:

Oyster River
VRAP 2001 River Graphs

Appendix E:

VRAP 2001 Field Sampling Protocols